THE

ELECTRICAL REVIEW.

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CONTENTS:

	PAGE
Municipalities and Private Enterprise	357
The Institution of Electrical Engineers	360
The Telephone Service	360
A Carbide of Silicon Lamp	361
Correspondence:—Block Signalling	362
Queensland Telephone Service	362
Is Tendering Becoming a Farce	363
A B C Arc Lamp	363
Legal:—The Castner-Kellner Alkali Company, *v.* The Commercial Development Corporation	363
Cooper *v.* The Electric Installation Company	365
Business Notices, &c.	366
Canterbury Corporation Electricity Works (*illustrated*)	375
The City of London Electric Lighting Company's Works (*illustrated*) (*continued*)	382
City Notes	387
Traffic Receipts	390
Share List of Electrical Companies	391
Market Quotations	392
Systems of Stoking	393
The Okes-Serve Water-tube Boiler	393
Electric Traction in Porto Rico	394
Electrical Exhibition at Brussels, 1899	394
The General Power Distributing Company's Bill	394
Bedford Electric Lighting Plant (*illustrated*)	395
Ocean Telegraphs	396
Carbon-Consuming Batteries	396
Cooling Tower and Condenser Plant	397
Electricity as Applied to Metallurgy	397
Steam Turbines (*illustrated*) (*continued*)	397
The Telephone Question	399
New Patents	399
Electrical Patents of 1885 Expiring in March, 1899	400
Abstracts of Published Specifications	400

THE

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MUNICIPALITIES AND PRIVATE ENTERPRISE.

Two events of high importance to the future of the electrical industry in this country have occurred since our last issue went to press. On Thursday of last week Mr. Balfour declared the intention of the Government to appoint a Joint Committee of the two Houses to investigate the propriety of municipalities entering upon trading enterprises. On the following day the House of Commons rejected the second reading of the General Power Distributing Bill.

These two events must, we think, be considered together, and seem to point to a desire on the part of the Legislature to start with a clean slate. It is as if they did not wish to hamper the Committee to be appointed by expressing an opinion on the issue between municipalities and private enterprise as to which of them shall be entrusted with the development of electrical undertakings in Great Britain.

If this correctly expresses the attitude of our lawgivers, it is another instance of the passion in the Anglo-Saxon breast for forming a ring round two disputants and giving the best man its philosophical benediction and a chance of winning on his merits. For it will be seen that in these two cases the parties are contending for one substantially identical principle—the municipalities demanding the right to compete with established trading enterprises, while the private capitalist seeks powers to compete with established municipal undertakings. So far as regards the present. And it is probably this aspect of the case which appeals to the casual observer, and prompts his feeling that neither party should enter the ring handicapped by the weight of some prejudgment in favour of his adversary. The powers that be have accordingly struck out the trading clauses in the Municipal Bills, and rejected the General Power Bill bodily, and, feeling that they have acted with a traditional sense of compromise and fair play, now leave it to the combatants and the Committee to do the rest.

There is, however, an important difference between the parties which vitally affects the electrical industry, and which constitutes the real issue in this matter, namely, the question of the future. Without bowing the knee to the fetish of "unrestricted competition," so precious to the Manchester school—an idol whose Juggernaut creed is becoming increasingly hateful to many men—it is not too much to say that the opposite extreme of "no competition" is one in which every fair-minded man must detect the gravest peril for our industrial and scientific advancement. And there is only too much reason to fear that the cause of municipalism is largely wrapped up with the latter; for while the General Power Distributing Bill sought no monopoly, present or future, the spokesmen who opposed it frankly claimed for municipalities exclusive rights in regard to any undertakings established by them. To

lovers of the picturesque, Mr. Stuart Wortley's entreaty to the House to show "unlimited respect and jealous watchfulness for the integrity and independence of municipal privileges" may appeal, but it would be a comfort to feel that the Legislature realises all that is involved in the policy of which he made himself the exponent. Briefly expressed, the claim of the municipal advocate comes to this, viz. :— that municipalities should have the right to compete with established private interests wherever they exist, and to permanently exclude their competition wherever they do not exist.

Taking all things into consideration, however, there is ground for satisfaction with the course of events. An opportunity is to be afforded for letting in the light upon the march of the electrical industry during recent years. It is important that that light should be full, clear, and from all sides. Our over-worked House of Commons cannot revise questions of this kind and strike a new balance more than once in a generation ; and it is therefore proper to realise that the policy it will shortly lay down on the strength of its Committee's report will become the unchangeable path of destiny for the electrical industry for many years to come.

There is no fear that the case for the municipalities will be weakly presented, since their organisation is compact and their purse unlimited. It behoves the advocates of private enterprise to look to it that their case is equally well prepared. The action of the Government and the small majority against the General Power Distributing Bill afford evidence that Parliament is becoming interested and educated in the issue which is before it, and that members are desirous of exercising their own judgment in spite of the *mot d'ordre* from the municipal organisations, to which Mr. Bromley Davenport frankly confessed, to wreck the Power Bill at all costs.

For the welfare of the public, equally with that of electrical progress, it is urgent that those who conceive that municipalism is going too far should arouse themselves from a policy of *laisser faire*, and not fall into the common error of supposing that matters will right themselves without individual and collective effort on their part.

A representative Committee of the London Chamber of Commerce has undertaken the heavy task of presenting the case for private enterprise before the promised Joint Committee. It is the imperative duty of every one who is concerned in having the facts brought into the light for public consideration and judgment to support them. And in this we would urge the co-operation of the many other trades and industries upon which the collectivist doctrine has been encroaching since the Legislature last defined a common policy.

Wireless Telegraphy.

Perhaps the most noteworthy characteristic of the latest form of apparatus adopted and adapted by Mr. Marconi is its simplicity. In the early days of these experiments we were told how necessary it was to attend to the surface and size of the spark-spheres; it was generally supposed that they should be highly-polished solid brass balls, several inches in diameter, arranged three or four in a row, in an oil bath. At his very successful lecture last Thursday week, Mr. Marconi demonstrated that such refinements were unnecessary; he declared that better results were obtained by using unpolished balls of about 1 inch diameter, sparking in free air. This result is so suggestive, that the whole matter seems to require revision from the commencement. Experiment has certainly shown that true Hertz waves are propagated with greater facility from highly polished balls than from dull ones; hence we are inclined to ask, are we now dealing with true Hertz waves, or with "electrification" as known to Benjamin Franklin? Highly polished balls of considerable capacity are undoubtedly conducive to "snappy" sparks, the precursors of true Hertz waves. Dull surfaces, on the other hand, may produce a greater "electrification" of the air, especially when assisted by convection from the vertical inductor wire. The paradox with regard to the earth wire may also find an answer in the supposition that the signals are transmitted partly by true Hertz waves, partly by static induction, and partly by the phenomena associated with brush discharge. In other words, we appear to be harking back to the experiments of Edison (see "Telegraphie sans fils," an article in *Le Mouvement Economique de Bruxelles*, dated February 27th, 1892), quoted by Capt. Benest in his paper of the same year on "Coast Telegraph Communication." Edison there says he has discovered that if the apparatus is placed at "a sufficient height to be no longer interfered with by the curvature of the earth, and to reduce to a minimum the terrestrial absorption, one can transmit, from distant points, telegraphic messages or signals over large expanses, as, for instance, between two ships, or to establish communication between a ship and the shore." As this article may be difficult for reference, a little more may here be quoted. "In the last case, to augment the height of the point of reception to the earth, he would employ balloons. At sea, at an elevation of 30 metres, communication can be transmitted to great distances, and the masts of ships supplied with metallic plates is all that is required. Connection with the earth is established, and the secondary circuit of an induction coil is placed between a condenser and the ground. The primary circuit is provided with a battery and some arrangement to produce signals. In transmitting signals from one ship to another, one can communicate when traversing wide seas, or even oceans. Collisions during fogs can thus be prevented." These early experiments of Edison are especially deserving of attention, from the circumstance that the 30 metres of vertical inductor-wire used by Edison in 1892 happens to be almost exactly the height of the wire used last year by Mr. Marconi at Osborne House for signalling to the Royal yacht. The idea of simplicity which begins at the oscillator and is carried entirely through Mr. Marconi's apparatus to the coherer. The coherer he uses is a glass tube about four cms. in length, into which are fitted two silver cylinders that approach one another to within a few mms. Platinum wires are sealed into the ends of the tube, and connection is made with the silver cylinders through small brass rods to the platinum wires. The narrow chink between the flat ends of the cylinders is filled with a mixture of nickel and silver filings, just as they come from the file, and a small quantity of mercury. When the coherer is in the decohered condition its resistance may be several megohms ; but when cohered it falls to something between 100 and 500 ohms. It is evident that a great deal of care has been bestowed by Mr. Marconi upon the damping of all secondary influences and "extra currents" in the coherer circuit, by judicious use of impedance coils in series, and non-inductive coils in parallel, with the windings of the magnet of the "tapper-back" and the relay. The signals appear as very perfect dots and dashes on the ink-writer; and the lecturer assured his audience that when the conditions are properly understood the coherer is as trustworthy as any ordinary telegraph receiving instrument.

But it is to the vertical inductor-wire that Mr. Marconi attributes the greater part of his success. He has adopted a copper strand (7/20) as a useful size, with a height of 20 feet for 1 mile, 40 feet for 4 miles, 80 feet for 16 miles, and so in proportion to the inverse square of the distance to be traversed by the signals. As in Edison's experiments, it is by these vertical inductor-wires that intervening obstacles are overcome. Mr. Marconi threw out a half suggestion that in this case "the oscillations might pass along the earth." His experiments agree with others in proving that horizontal wires are far less effective than vertical ones. Our suspicions stated above as regards Hertz waves pure and simple are further strengthened by Mr. Marconi's results with parabolic reflectors. By means of reflectors, he sends out a more or less parallel beam, after the manner of Hertz, Lodge, and others; but, for some reason or other, the signals in this case were not interpreted at a distance much greater than $1\frac{3}{4}$ miles. Within that distance, a motion of the reflector could throw the receiving instrument in or out of field; and the beam had a radius of something like 50 feet at the distant station. It is to be hoped that full details of this interesting experiment will be published in the *Journal*, especially as regards earth-wires, polished and non-polished balls, and all metallic connections, and as to what, if anything, happened just beyond the $1\frac{3}{4}$ miles. Also, we should like to know how far, if at any distance, signals could be obtained *behind* the reflector. Unfortunately, the meeting was very much over-crowded; we could neither see the lecturer nor his experiments, but we understood him to say that in these reflector experiments no inductor-wire was used. It would clear the air if these two cases could be considered separately, *i.e.*:—(1) With inductor wires, no reflectors; (2) with reflectors, no inductor wires. In the first case the distance traversed in Mr. Marconi's experiments was 18 miles; in the second case $1\frac{3}{4}$ miles. One consequence of the simplicity of the apparatus is to raise our hopes as to its practical utility on the financial score. The induction coil employed for the greater distances, we understood the lecturer to say, takes from 6 to 9 amperes; it gives a 10-inch spark in air. The actual spark-gap between the 1-inch diameter spark balls is about $\frac{3}{8}$th-inch. The tapper-back is not much more than a single-stroke bell with a large number of windings. It has a resistance of about 1,000 ohms. The impedance coils are simple telephone bobbins. The inductor-wires cannot cost much to fix, and considering the number of "anticipations," the royalties on patents cannot amount to much. We congratulate Mr. Marconi upon his demonstration of the comparative cheapness of wireless telegraphy, its simplicity, the distances over which it is effective, and the practical proof that the coherer responds faithfully in all weathers, and that it has no inherent tendency to fail. If our sketch of the lecture is lacking, we must ask our readers to make some allowance for the discomfort and difficulty with which the proceedings were heard. Is it not a reproach to the present age, that here in this beautiful City of the Sciences we have no lecture theatre worthy of our scientists? That at the Royal Institution is a death-trap, only awaiting an alarm of fire, to cause a catastrophe which will disgrace the name of British science to all time. That specious piece of vanity, the Imperial Institute, if rightly organised, and administered in a truly imperial spirit, would afford a magnificent auditorium, a fitting tribute by the Empire to learned societies, to whom, in no small measure, it owes its greatness.

The Midland Railway (St. Pancras) Installation.—The Midland Railway Company has just established a very extensive coal depôt in Pancras Road. The lower level is lighted electrically by means of 104 10-ampere arc lamps. Hydraulic lifts let the loaded trucks down from the upper to the lower level, and in like manner raise the empty ones. Extending along the west side of both levels is a traverse road to transfer the trucks from one road to another. These roads are to be worked by electricity. They would be in operation now but for the engineers' strike, which prevented the completion of the traversers. Pumps, also electrically driven, are being erected for supplying water for the service of the hotel, station, locomotives, &c. It is stated that there will here be probably one of the largest electricity generating stations for railway purposes in this country. It is situated at Kentish Town, and the plant installed there is intended to supersede the isolated plants now in the hotel and at the Somers Town goods depôt. At present it consists of four Lancashire boilers, each of 300-H.P. capacity, duplicate pumps, steam economiser, and exhaust feed heater. In the engine room are three coupled steam dynamos—the engines being of the Willans type, while the generators are by Messrs. Thomas Parker, Limited. Each dynamo is 200-kilowatt capacity. Two exciters with a set of accumulator cells and the usual switchboard complete the present installation. A direct current system has been adopted because the electricity is required for both power and light. The current is generated at from 2,000 to 3,000 volts and conducted by concentric cables encased in lead and protected by steel ribbon armouring to the several transformer rooms at Kentish Town station, St. Pancras goods station, and St. Pancras passenger station. The cables are in duplicate, and are mainly laid underground, protected with railway sleepers. The transformers are of the rotary type, and their output varies from 50 to 100 kilowatts. At the first-named point there will be two of the smaller size, at the goods depôt four of the same size, and at the passenger station four of the larger size. From this installation, power is also to be supplied for various other purposes, thus requiring an increase in the plant.

French Boiler Accidents in 1897.—*Le Journal Officiel* reports that during the year 1897 there were 45 accidents to steam boilers in France, causing the death of 26 persons and the injury to 26 also. Of these, seven were to boilers at electric works of water-tube type, and of these, six only required the replacement of certain tubes, and one only at Avignon caused injury to two employés. One-third of the whole number of accidents were to water-tube boilers of small elements, but these accidents account for only one-ninth of the deaths and one-ninth of the injuries, causing 20 days' incapacity from work. Of 62 causes of accident, 19 are set down to defects of establishment, 19 to defective working, 18 to bad conditions, and six to undefined causes, the larger number of causes than cases being due to a plurality of causes. In electric works, the majority of the accidents are stated to be due to overheating caused by scale, shortness of water, or other reasons. We have not figures by us to compare the number of boilers in France and their mishaps with the figures for Great Britain.

Electrical Oscillations.—When the vapours of various chemical compounds are exposed to the influence of electrical oscillations, various results may occur:—(1) The vapour may become luminous; (2) it may be crossed by spark discharges, usually of a green colour; (3) it may remain dark, at least until a very high tension is reached. The behaviour in this respect of over 50 compounds was investigated, and, although general deductions cannot be drawn from so few observations, yet some constitutive influences are indicated. Thus, almost all the aromatic amines become luminous, and present more or less similar appearances, whilst the ease with which luminosity occurs appears to be in part dependent on the basic character of the amine, as compounds which, by substitution, have lost their basic nature (for example, nitraniline or tribromaniline) are no longer rendered luminous. This rule, however, cannot be extended to cyclic compounds containing nitrogen. Amongst hydrocarbons, the aliphatic compounds and the simple benzine compounds remain dark until a very high tension is reached; but most of the hydrocarbons containing two or more benzine rings readily become luminous. In all cases, it was observed that, during luminosity, the vapour acted as a conductor. The above is an abstract of a paper in the *Zeitschrift für Physikalische Chemie*, 1898, 26, 719—727.

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THE INSTITUTION OF ELECTRICAL ENGINEERS.

The Institution of Civil Engineers' theatre was crammed to overflowing at the meeting of the Institution of Electrical Engineers on Thursday evening last week, when Mr. Marconi read his paper on "Wireless Telegraphy." The paper was quite fresh, not being in print, and Mr. Marconi mentioned that it was only completed that morning. Visitors crowded the meeting hall, and 10 minutes before 8 o'clock the only seats remaining unfilled were those improvised on the door cornices, whereon half-a-dozen adventurous spirits found a resting place.

Before taking the paper Prof. Perry, who occupied the chair, announced that an interim report had been presented by the Uniformity Committee on the question of frequency, the following standards being recommended:—

25 periods per second for power distribution;

50 periods per second for ordinary electric lighting purposes; and

100 periods per second for the special case of high tension distribution in the electric lighting of scattered districts where house transformers were essential.

The paper was illustrated by a few experiments. On completion, Prof. Fleming was called upon to open the discussion, which he did by offering Mr. Marconi most hearty and united congratulations on behalf of those present. The lucid and interesting paper then read was an addition to the debt that many of his hearers would feel they owed Mr. Marconi. Very little could be added by anyone at the present time to what had been said, but the speaker thought some questions might be asked to elucidate some interesting points in connection with the apparatus. The first was, had the use of oil been abandoned? Dr. Fleming believed that originally the spark-gap of the transmitter was immersed in oil, but from experiments he had made he found that the oil was practically no advantage. The reason might be that air passes suddenly from an imperfect to a very perfect conductor, and although the greater dielectric strength of oil would enable higher electrical pressures to be used, the carbon deposited on the balls due to partial decomposition of the oil prevents extreme suddenness in breaking down. The second point had to do with the coherer; formerly Mr. Marconi exhausted the coherer tube. Had he found that vacuum was no advantage? The sensitiveness of a coherer appears to depend upon the exact filings used, and an open tube which permits filings to be exchanged is a convenience. The last question was whether mercury was put with the filings? He had tried uranium mixed in a finely powdered state and found good results. A most interesting point was the use of a long vertical wire; a number of experiments made in the courtyard of University College had shown that with conditions such that no signal was obtained with a horizontal wire, when the wire was put vertically and the other pole earthed a loud response was obtained.

Dr. Erskine Murray, who assisted Mr. Marconi in his experiments, then spoke. He gave an illustration of the possible advantage of earthing, by citing the collection of the charge in an ordinary frictional machine by points. The tension was greater on a point than on a smooth surface, and the surface density increased on the vertical wire, projecting up from earth, as one went up. This might be an argument in favour of earthing the opposite pole to that connected to the vertical wire.

Mr. Evershed reminded the meeting he had done some work in similar fields, but had never made even a single experiment on Hertzian telegraphy. He had been hoping to have the advantage of hearing Marconi in the meeting room of the Institution. The various points upon which questions might be asked appeared to him to have been answered very fully. The law relating to distance and height of conductors given was exceedingly simple. In his experiments he had shown that the induction depended upon the product of the areas of two circles. Dr. Fleming referred to the integration of electric force into potential, in the discussion on a previous paper on telegraphy without wires. The explanation of the law seemed to be that if you double the length of one of the wires you doubled the effect, and if you double the length of both, the effects would be quadrupled. Before sitting down Mr. Evershed desired to refer to one other matter, *i.e.*, the transmission of signals to lightships. He had made experiments on this interesting subject which in one case resulted in a complete failure. He wanted to be the first to congratulate Mr. Marconi upon having succeeded.

A speaker asked the author some questions as to his means of establishing and maintaining an earth. Mr. Granville followed with congratulations and one or two questions. Was the height of the vertical wire measured from sea-level or from the height on which it stood? Did neighbouring conductive masses create any difficulty?

Major Brett referred to the success that had been attained over unexpected distances. He believed that the earth connection was at any rate not necessary for speaking over a distance of 12 miles. He thought it and the vertical wire assisted in conferring an oscillatory character on the discharge.

A member of the Trinity House confirmed the success attained in speaking to lightships; there was not any hitch at all. He was followed by Captain Kennedy, who mentioned the paper read by himself about a year ago at the United Service Institution dealing with the military applications of wireless telegraphy. There was occasionally difficulty in getting up a pole, but by a balloon or kite long lengths of wire could be got up. He had in one instance two miles of wire up, and got strong atmospheric effects such as 6-inch sparks. He closed his remarks by a few allusions in a humorous vein to Mr. Marconi's nationality, and his being guilty—or thought so by some people—of "every crime known to the Patent Office." Prof. Perry reiterated the question, "Why should there be an earth connection?"

Owing to the crush and the late hour we were promised the continuation of the discussion last Thursday (yesterday) evening, and, furthermore, it was stated that arrangements would be made for the re-reading of Mr. Marconi's paper at a later date in the present season.

THE TELEPHONE ERVICE.

Mr. Hanbury laid before the House of Commons on Monday afternoon his proposals for the re-formation of the telephone service. The reform is to be attained by competition, and the competition is to come from two sources. In the largest and the smaller cities of the kingdom the Post Office itself will be the competitor. In cities of over 50,000 inhabitants, except London, the municipalities are to be encouraged to develop services of their own. For the purposes of the Post Office competition, a preliminary sum of two millions will be allotted, and local authorities will be enabled to raise or apply money for telephonic purposes. The reception of the proposals by the House in Committee leaves little room for doubt about the passing of the Bill when it is introduced. Mr. Hanbury's speech was very ably delivered, and covered a good deal of ground. He primarily devoted his attention to demonstrating the right of the Post Office to compete, and took up, partly seriously, partly in a spirit of badinage, various points in the recent speech of Mr. Forbes to his shareholders. He expressed the desire of the Government to deal fairly with the National Telephone Company, but whilst making several telling points he can hardly be said to have given the impression of approaching the subject with absolute freedom from bias. His reference to the purchase of the trunk lines as having been a profitable bargain to the company by reason of their having obtained the cost of the lines plus 10 per cent., leaves out of account the fact that the trunk line transaction was not merely a sale of material but a surrender of a valuable right—exactly how valuable being, perhaps, only now properly recognised.

On the question of the understanding which was alleged to exist, Mr. Hanbury said:—"I ask, would it not be monstrous, in a public agreement of this kind, which was the only written agreement which the public could see, that there should be at the back of it, on the part of ministers or of any Department, any undertaking to the effect that that

agreement did not mean the whole of what it said?" To this question, it seems to us, there can be but one answer. It cannot be that one agreement is for the public eye and another, to a contrary purport, to be acted on. But does the question cover all the contingencies? May it not have been the policy of the Post Office at the time not to compete? And assuming that such policy may now advantageously be changed, is not the question one of morality rather than of the extent to which the company relied, or were encouraged to rely, on the permanence of that policy?

Since the champion of the company in the House did not question the right of the Post Office to compete directly or indirectly, it may be assumed that nothing further will be heard of the *lex non scripta*, and only the written agreement will be in evidence. The assumption of such a position will be very desirable. The right to compete being expressly reserved, nothing is to be gained by combating it, and the introduction of prejudice on both sides only tends to obscure the issue. The right to compete being established, its expediency remains to be considered, as well as the merits of the plans proposed by Mr. Hanbury. From the point of view of the telephone user and the telephone provider, it is unnecessary for us to repeat what we have so often maintained, that competition should be avoided. The telephone service should be a monopoly, and within the limits of a State should be a unit. We cannot then regard Mr. Hanbury's proposals as sound in principle, more especially when we observe that the dual control which now exists is to be still further subdivided. It is a little difficult to see whether the selection of the larger municipalities as a factor in the scheme is due to a recognition of their suitability for the work required or is an example of the policy of "playing to the gallery," from which Mr. Hanbury's speech was not entirely free. It is to be regretted that Mr. Hanbury had not the courage to treat the whole kingdom as he proposes to treat London. It is further to be regretted that he should have minimised in any degree the scope of the proposed London system. The selection of London for beginning active competition by the Post Office shows a far-sighted policy, which might well be carried further. The idea that the Government should supply the poor man's service, whilst the company obtains the benefit of the rich man's subscriptions, is not tenable. With the facilities at their command, and the abilities under their control, the Post Office are exceptionally well placed for the establishment of a London system, and Mr. Hanbury seems to us to have lacked some appreciation of the circumstances in minimising its effects.

The proposals for the acquisition of the respective plants of the municipalities and the company in 1911 are somewhat crude. There will be a pledge to purchase "all that is good and useful" from the municipality, and a similar pledge to the company, provided they are "reasonable" and give facilities for the intercommunication of municipal and national exchanges.

This is a reflection of one of the conditions of the Treasury minute, as to which we remarked that it would be impossible to devise a method for determining equitably the scale on which 10 subscribers to a new exchange should have the right to communicate with 1,000 subscribers on an already established exchange. On such points as these we must reserve criticism until the details of the Bill are disclosed. One other criticism of Mr. Hanbury's remarks must suffice. His estimate of the cost of replacing the National Company's plant, and thus appraising its value, was obviously too low, and he might, without loss of dignity, have receded from it, instead of maintaining it.

If two millions are required to begin competition by one of the competitors, it is reasonable to infer that two millions cannot suffice to replace the plant which represents the growth of a number of years. The company's valuation may be equally at variance, but by a fair and equitable appraisement the Government should be able to acquire the whole business of the country, to avoid the waste and inconvenience of competition, and eliminate the interposition of the third authority which is avowedly only a temporary expedient. The telephone system, as we have already said, should be a monopoly; it is a branch of the Post Office and should be under its direct control, not only in part but in its entirety.

The telephone service has for so long a time needed placing on a substantial footing that we cannot look forward with satisfaction to a further period of experimentation and divided control, only to be combined and regularised 12 years hence, when its natural growth will have made the task one involving a further number of years' work and a further huge expenditure.

Paraphrasing Mr. Hanbury's observations on the moral law, it may be observed that the view of what is "reasonable" "is apt to vary with the individual requirements of the interpreter;" but, with a decided policy on the part of the Government, and a freedom from prejudice in the negotiations, it ought not to be difficult to settle the telephone question at once with advantage to both sides, and with the inestimable benefit to the public of placing not a part, but the whole, under Government control in the hands of the Postal Department who alone are in possession of all the elements needed to undertake the work satisfactorily.

A CARBIDE OF SILICON LAMP.

Some days ago, on the invitation of the Premier Electric Lamp Syndicate, we visited some small works at Huyton, near Liverpool, where for some time past a lengthened series of experiments has been carried out with a carbide of silicon incandescent lamp. It is now claimed to be in a practical and commercial form, and in all probability a company will be shortly floated—with adequate capital—to manufacture and sell the lamp.

The process of manufacture, as explained to us, possesses some unusual and interesting features. In the early stages of building up the filament of an ordinary incandescent lamp, either cotton or similar material is converted into cellulose, but the method adopted in the Premier lamp differs materially from this. First of all, German filter paper—a kind of tissue paper chemically cleaned of impurities—is treated with sulphuric and phosphoric acid until a gelatinous substance is obtained. To this is added a special form of silicon powder (the chief factor of the lamp) and the whole mechanically mixed together. The next step is to place the mixture in a metal vessel, the bottom of which is composed of fine metal gauze. This vessel is screwed to a second one and these are fixed on a rotating frame. Upon this being revolved it is found that the action of centrifugal force is sufficient to drive the pasty material through the gauze into the second vessel, and it is claimed that this frees the paste from air bubbles. The vessel which now contains the whole of the mixture is then fixed in an aperture on the top of a glass box, and a form of plunger or piston is fixed into the vessel. A weight being placed on the plunger, presses it slowly down, and the material is squirted through a die at the bottom of the vessel. The die is made from a jeweller's ruby, which is found to act better than anything else. As the material is squirted in the form of a fine thread from the metal vessel into the glass case, it comes almost immediately into contact with alcohol, which has the effect of hardening it; the material then continues its progress through a glass tube, until it reaches a glass receiver, where it coils into regular layers. At the same time a constant circulation of water is kept up, and the material is very freely washed. After a complete washing, the glass receiver containing the coil of material, which is now quite hard, is removed, and the thread is slowly wound on to a wooden frame, where it remains for some time until thoroughly dry. It is next wound on to carbon forms, the shapes of which vary according to the kind of filament desired, and the thread is ready for the carbonising furnace. In the furnace the forms are surrounded by a mixture of carbon powder and rutile, and the temperature is slowly raised until it reaches the point at which the silicon combines with the carbon. The filaments are flashed in a vapour of silicon and carbon. A liquid of this material is forced round the filament, and upon a current being sent through the filament it becomes red hot, and transforms some portion of the liquid into vapour. The remaining features of manufacture present nothing unusual. The bulbs are exhausted by mercury pumps, and the vacuum tested in the usual way.

It is claimed for the lamp that the material of which the filament is composed, makes it exceedingly economical

throughout a fairly long life, the consumption of current per candle varying from 2·5 to 3 watts. There is also, it is said, very little blackening. We were shown some lamps which had been running for 400 hours, and it was certainly difficult with the naked eye to notice any difference as regards illumination between them and new lamps.

At an informal meeting of the syndicate held subsequently at the Lime Street Hotel, Mr. L. Higginbottom, the chairman of the Manchester Corporation Electric Lighting Committee, made some remarks on the financial aspects of the concern, which were no doubt vastly encouraging to the members of the syndicate.

CORRESPONDENCE.

Block Signalling.

Owing to absence on sick leave, it was only when too late to deal with it in your last issue, that I noticed Mr. Pigg's letter in that of the 24th ult.

On the receipt of Mr. Pigg's book with a request that I would review it, I wrote you that I should prefer you placing it in other hands. It was a work which I did not covet; you, however, urged me and I acceded to your request. I have neither the time nor the desire to enter upon a contentious discussion whether my views or those of the author are correct, or if I have in any way exceeded the bounds of reasonable criticism. That I must leave to the judgment of your readers. I have stated that "although not new there is much interesting reading in the work," and where I have differed from the author I have endeavoured to frame my observations in language as inoffensive as possible. Can I say the same of your correspondent? Mr. Pigg has called my attention to three instances in which I appear to have misread or misunderstood the points referred to, and I need not say that I at once desire to rectify them. Read by the light of Mr. Pigg's remarks, I recognise that my deductions from p. 119, with respect to fog signalling, are erroneous, and I unhesitatingly withdraw them. Considering the subject in relation to the prevailing practice, I concluded that the expression "Hence it would appear that the driver is the most suitable person to say when *he* requires additional means to enable him to obey the signals shown," indicated that the driver was the most suitable person to determine when fog signalling should be adopted. I equally readily recognise the author's corrections in reference to figs. 38 and 106. I am, above all, desirous that I should not be guilty of anything approaching an injustice, or that is capable of any such interpretation, and on again referring to the figures I quite admit that in each instance my notes misled me.

I was, of course, when penning my remarks in reference to the Bagsworth incline and the Ambergate block, quite aware it was but a two-wire system, but I preferred to put it in the manner adopted. Each wire had upon it, in circuit with the needle instrument, what was known as a "peel" bell—a clockwork bell, which had to be wound up in the same manner as a clock. These bells were provided with a *button* switch for putting them in or out of circuit. The same description of bell was, in the early days of telegraphy, when messages were few and far between, employed to call attention at telegraph offices. The object of the bell in this instance was to call the attention of the man entrusted with the signalling. The handle of the needle instrument was moved to and fro. The current in attracting the armature of the bell coils, released the mechanism, and the bell continued to ring till it was switched off by the signalman, who then attended and responded to the signals rendered on the needle.

I cannot agree with Mr. Pigg that Permissive block work still exists. There are points, of course, such as stations or other places where trains have to meet and exchange traffic, and for a certain portion of the approach to such points trains must necessarily come under a permissive mode of working. This is accomplished often under a special type of instrument or by bell signalling; and on lines devoted entirely to goods and mineral traffic such trains are generally worked by bell signals, and may possibly be worked by other instruments, but, of course, this is not "block" working in the general acceptation of the term.

The author will, I am sure, accord me a grain of knowledge on the subject of earth troubles and earth currents; and I think, too, I may lay claim to have had as much to do with linemen as himself. We may differ as to the terms made use of, but few will, I think, dispute that earth currents are due, as I have stated, to changes in the earth's electrical potential, and the only reliable mode of getting rid of them is to divest the circuits of all earth connections, and it is for this reason that metallic circuits are now generally employed with the Tablet or Electrical Staff block.

Reference to the concluding portion of my remarks will scarcely, I think, commit me to the categorical manner in which the author has set them forth in his communication. It is quite true that I have pointed out that in practically all the useful adjuncts referred to by him the names of those by whom they were invented, or introduced, are not mentioned. I am of opinion, and I doubt not, others also, that considerable credit attaches to the authors of these extremely useful appliances. It is now many years since the electric repeater and the light indicator were introduced. To the late Mr. Warwick we owe the latter, to Mr. W. H. Preece the former. Each have, no doubt, since their introduction been very much improved and varied in form. Turning to the later figures produced in Mr. Pigg's book it is impossible to avoid noticing some in which the writer may fairly claim some consideration. The application of the telephone to the block bell (fig. 125), although merely an adaptation, has proved of immense value to the Midland at all events, and, I believe, to other companies. The repeater arrangement shown in fig. 107, which was, I believe, first adopted by me, has resulted in large savings—one wire only being needed between the signal post and the signal box, instead of two as hitherto. The improved "expansion bar" (fig. 108), as also the arrangement shown in fig. 109, is a Midland introduction. I think I may also claim the invention (many years since) of the "point" indicator, fig. 111. Such an indicator and contact maker is, I believe, shown in my old book. There is not, of course, very much to boast about in this, still it is pleasant to find when these things are placed on record that one's labours have not been forgotten, and although I have made these remarks personal to myself, purely because I am able to identify the apparatus, I doubt not the same feeling with regard to *their* labours will be found to animate others. Of course the author may not have known to whom to attribute many of these inventions, although probably their authorship might readily have been ascertained. I do not in any way attribute to him intentional discourtesy. Of that I am sure he would not be guilty, but it is a point which perhaps he might, and no doubt will, in future editions of his work, be desirious to bear in mind.

I have to express my regret that I should have so far encroached upon your space. It was not my intention to have allowed my remarks to extend to such a length, my chief desire being to correct the errors to which I have referred.

W. Langdon.

Derby, *March 6th*, 1899.

Queensland Telephone Service.

In your issue of December 2nd, 1898, you briefly review the 1897—1898 report of the Postmaster-General for Queensland. Incidentally you review the telephone working and the application of the "phonopore." In this portion of your review, the following statement, which may mislead your readers, appears.

"Interesting data is furnished in relation to the revenue derived from the wire between Charters Towers and Townsville. As has been pointed out, it is but one wire worked telegraphically, and the phonopore has been superimposed upon it. . . . . Queensland, so far as Charters Towers and Townsville are concerned, is at present content with one wire for its telegraph work, and practically one wire for telephone work."

Now, between Charters Towers and Townsville there are in sections from 16 to 8 wires. One wire is not used for telephone purposes by having a phonopore superimposed upon it (it would be unworkable on an 83 mile section carrying so many wires), but two of the lines are used on the Van Rysselberghe system. This was never regarded as a permanent arrangement, but as a means of filling a gap till the copper line, since approved, could be erected.

The use of phonopores is confined to outlying districts where a single wire is sufficient for the telegraph business, and where there can be no objection raised to the "toot" of the phonopore telephone call. There, the vacant round hole of desired cheap communication was perfectly fitted by the round peg of the phonopore telephone. Of course, it would not be suitable for extended use in England. Though greater objection would be found to the phonopore telegraph with its *continual* "toot," than to the *occasional* call on the phonopore telephone.

John Hesketh,
Government Electrical Engineer.

Brisbane, *January 23rd.*

Is Tendering Becoming a Farce?

May I venture to place before you a matter which is of importance to a large number of electrical firms who cheerfully undertake the trouble and expense of responding to the advertisements of local authorities in their desire to obtain tenders for certain works.

In October last the Knowle Asylum, Fareham, advertised for tenders for the lighting, &c., of the asylum, they asked for deposits of £10 in bank notes for specification, &c.; it was necessary to make a survey of the building, and I, with many others, went to considerable expense in order to accurately make out my estimate; tenders were sent in and after some delay, and without any explanation, the committee accept a tender which was not the lowest. Mine was lower than the one accepted, and I certainly think some explanation is due from the committee. I have had considerable experience in the work, having installed plants for two asylums and also for the Metropolitan Asylums Board, so that on the score of experience I could not be rejected.

I am quite prepared to admit that the lowest tender should not necessarily be accepted, but good reasons should be given if it is not so. Public bodies have not the slightest objection to allowing a number of firms to spend £20 or £30, but there should be some morality in it, if these local committees have already decided in their own minds that a certain firm shall receive the order, then tendering is a farce.

In this case the committee should, without further delay, state clearly why they accept a tender which is a local one but not the lowest; I will personally allow them to make any statement as regards myself and hold them irresponsible.

It is time these kind of things should be protested against.

T. Scott-Anderson.

A B C Arc Lamp.

Being away, I did not see your issue of the 10th ult. until this morning. In reference to article under the heading "A B C Arc Lamp," page 198, it may be of interest to some of your readers if I point out that in the year 1887 I made and used for some time in one of my lamps a mantle similar to the one described in the above article.

I may add that this lamp was hung and used for some time in one of my client's showrooms. It behaved perfectly satisfactorily, but owing to the trouble and expense incurred by the frequent renewal of the mantle, I abandoned the idea, otherwise I should have duly protected it.

I find that my present system in the "Jackson-Mensing" arc lamp, where I use carbons of certain sizes, sufficiently compensates for the use of my former mantle.

L. C. H. Mensing.

[The mantle is only one of the features of the A B C lamp; its chief merit is in the use of a closed magnetic circuit.—Eds. Elec. Rev.]

[Correspondence.—Pressure upon our space compels us to hold over until next week, a letter from Mr. P. Kilduchevsky on the "Kilduchevsky-Mega Telephone Transmitter"; also one from Mr. C. J. Little on "The Absolute Block System of Signalling on Railways."]

LEGAL.

The Castner-Kellner Alkali Company, Limited, *v.* The Commercial Development Corporation, Limited.

(*Continued from page* 330.)

Third Day.

On Thursday Mr. Terrell, Q.C., continued the reading of the evidence, at the conclusion of which he asked their Lordships to take particular notice of the fact that Lord Kelvin had stated that the great advantage in Kellner was the fact that the mercury was undisturbed. Kellner aimed at a steady pool. Lord Kelvin was not referring to "steadiness" with regard to the vessel containing the mercury, but to the steadiness of the mercury *per se*. The object was to get the mercury quiet and unagitated. Lord Kelvin had said that the less the mercury was stirred and agitated the better, and that was his view of Kellner's patent. Having regard to his view of Kellner when he drew that specification, one must agree with Lord Kelvin. But when you came to Rhodin, Rhodin said he was going to drive his apparatus at high pressure. He said, "I am not going to have an alternating system which would necessitate that I should have richer mercury at one moment than at another." Rhodin said, "I am going to have a good churn up." How, then, could it be said that Rhodin who professed intended and did—as the evidence showed—aim at stirring up the whole of the mercury could infringe a patent which it was admitted had for its object the keeping of the mercury as quiet as possible. He submitted that it could not be said, on the evidence of the plaintiffs' witnesses even that the defendants had infringed the plaintiffs' patent for that reason. The defendants, however, said that even if they did infringe the plaintiffs' patent, that patent was bad for disconformity, because if the defendants had infringed this patent, they infringed figs. 7 and 8. If the defendants infringed those figures, those figures described the same thing as Rhodin's did, viz., the agitation of the mercury, and the transference of the mercury in that way from one cell to another, which was opposed to what Kellner did in his provisional specification. The defendants said that if they had infringed that patent for the very reasons that they had infringed it, there was disconformity. The defendants also said that there was no subject matter. The learned counsel asked their Lordships on this part of the case to look at Castner, and to consider the state of knowledge at the time Castner came into the world. He submitted that if there was any invention at all in Kellner it was the keeping the mercury still. It was what Lord Kelvin described as the to and fro intermittent movement in the provisional specification. His submission further was that there was no subject matter in the invention, and that the defendants had not infringed it.

Mr. Astbury, who followed on the same side, said that Kellner's was simply a paper patent. It had never been worked, and nobody knew whether it would work. The plaintiffs, who owned it, did not even run the risk of experimenting with it either in or out of court, and there was no evidence of utility in any way. The plaintiffs owned Kellner as well as two Castner patents. After the Kellner patent had come out, and the plaintiffs came to own it, they put up one of their works, but they did not choose to adopt the Kellner process, and he asked their Lordships to draw certain conclusions from that when they came to consider the evidence in the case. The defendants' case was that the Kellner patent was useless unless they did that which Castner did. He asked their Lordships to take into consideration the fact that there had been no attempt to show that the Kellner patent could be worked at all. Lord Kelvin had no information on the subject of the working of the patent, and, therefore, the evidence that the Lordships were asked to consider was that of two gentleman who spoke, of course, with very great weight theoretically, but the people who knew whether the thing was of any value at all, were not minded to put the machine to any test upon which the Court could rely. They therefore had this extraordinary thing, viz, that when the plaintiffs came to trial, they knew very little about their own machine. What was known at the date of Kellner? The whole process of extracting sodium from chloride of soda, and subjecting it to water for the purpose of getting out the caustic soda, was absolutely known. Castner was the first to show how this perfectly well-known process of electrolysis could be carried on in one machine instead of two. Dealing with the Rhodin patent, Lord Justice Williams said "the ribs of the bottom of Rhodin's are to prevent your mercury from revolving." Well, he agreed, for the simple reason that if they had a revolving bell with the mercury revolving round at the same rate, it was perfectly obvious they might as well keep the thing still. The only thing that produced caustic soda was the changing of the mercury from one cell to another. Therefore, the reason Rhodin had, and must have, ribs, was for the purpose of arresting the flow of mercury in a circular direction; but it did not follow that because it did not flow in one direction it was a stationary cathode. Mr. Moulton, in the Court below, invited Mr. Justice Bigham to say that stationary cathode in Kellner meant a mercury cathode which was stationary in relation to the vessel which held it. Now, with every respect to Mr. Justice Bigham, he asserted that it was just as little important to produce soda whether the mercury was still in its own vessel as it was whether the apparatus was standing on three legs or four legs. It was wholly immaterial, because the mercury had no action in relation to its vessel. The only thing that the mercury was acting upon were the bells. It was absolutely and wholly immaterial what particles of mercury flowed round in a particle of its own vessel, because, supposing that in Castner they moved the bottom round as well as their paddles, he supposed the learned judge, on the same theory, would hold he had a stationary

cathode in Castner. The result would be precisely the same. The whole object of the paddle in Castner was to stir up the mercury and to make it travel round from cell to cell. If they moved the bottom of his vessel as well as the paddle, then they would have what Mr. Justice Bigham had described as a cathode which was stationary in relation to its cell. But it was wholly impossible to suppose that stationary cathode in the case of Kellner in fig. 1, and Kellner never supposed he had a stationary cathode in figs. 7 and 8. The only part of the machinery which the mercury had to act upon were the bells, and when they had got their bells revolving, as in Rhodin, it was perfectly obvious that they must arrest the circular flow of their mercury. Otherwise they would not have any interchange between the mercury and the bells. And it was just the same in the other modifications of Kellner, and Kellner said in figs 7 and 8 he might either move his bells or move his mercury. Of course it was very convenient for his learned friend to keep to one instance, but why not take the other, for it was equally within Kellner's patent? Suppose he moved his bells, then he must not move his mercury round. But it did not matter whether he moved his mercury or whether the bells, because whichever he did he got the same agitation and the same transference of mercury from one cell to another as did Castner, and when once they grasped that point it seemed to him there was an end of the case. If figs. 7 and 8 either moved round bells relatively to the mercury or moved round the mercury relatively to the bells, what difference there was between it and Castner he was really unable to see.

The hearing was adjourned.

The hearing of this case was resumed last Saturday in the Court of Appeal, composed of the Master of the Rolls and Lords Justices Rigby and Vaughan Williams, on the appeal of the defendants from the judgment of Mr. Justice Bigham, sitting as an additional judge of the Chancery Division on August 3rd last. It will be remembered that the action was brought by the plaintiffs, who are the registered owners of letters patent, No. 20,259, of the year 1894, granted to Mr. Carl Kellner for an invention of improvements in the electrolytic apparatus for decomposing alkaline salts, and for an injunction restraining the defendants from manufacturing or selling caustic soda or other alkali in infringment of their letters patent. Mr. Justice Bigham gave judgment for the plaintiffs on all issues, hence the present appeal of the defendants.

Mr. J Terrell, Q.C., Mr. Astbury, Q.C., Mr. McConkey, Mr. J. H. Gray appeared as counsel for the appellants (defendants), and Mr. Fletcher Moulton, Q.C., Mr. Bousfield, Q.C., Mr. J. Graham, Mr. A. J. Walter, and Lord Robert Cecil for the respondents (the plaintiffs).

Mr. Astbury, resuming his argument on behalf of the appellants, said the point Mr. Justice Bigham held against them was that the mercury was stationary in relation to the cell which held it. He (counsel) did not care what rate it went at if it went at all. Lord Justice Williams asked what would happen if the ribs were taken away. If the ribs were taken away from the bottom it was quite obvious there would be more flow in the mercury, because the ribs, if they had any action, it was clearly in one way—an action which retarded the circulation of the mercury. It was put in there for the very purpose. Kellner had no ribs. In Kellner's, where he moves the bell as distinct from moving the bottom of the cell, he had no ribs, the mercury lying on a smooth surface. The middle partition of the bells would act as a thing pushing the mercury round and round. It had nothing to prevent it except the friction of the bottom. He submitted it was obvious in that portion of Kellner's machine the mercury would go round more quickly than in the appellants', but if it did go round in that way the machine was not working, because except so far as they got diffusion of sodium and the mercury not travelling quite so quickly, except so far as they could rely on that in the form of Kellner, the mercury would practically go round with the bells and then the machine would be equivalent to being at rest, because they would not have the change between the mercury and the bells which they were bound to have in order to have the alternate charging and discharging. The difficulty that had to be overcome was very clearly explained in Atkins & Applegarth. What he said was was this, "Where you have got your salt solution over your mercury, you get your deposit on the mercury, but before you can get that deposit of sodium out of your salt solution the oxygen in the salt solution will pick it up again, and you will get a mixture of caustic and water as well as of salt and water, and then the two electromotive forces will be counter to each other and one will block and stop the other. Castner overcame this difficulty, and there was no problem before Kellner, Kellner's was simply a detail of apparatus. Castner discovered, and he was the first man to discover it, that in order to get over this difficulty of the counter electromotive force they must completely stir up the whole thing.

The Master of the Rolls: Now, Mr. Moulton, do you mind taking the question of infringement first, because if we are against you on that it is no use going into subject matter and disconformity, but if we are with you on that we can take the other afterwards.

Mr. Moulton: May I tell your Lordships frankly why I do not accede at once? It is that I cannot help thinking that the argument before your Lordships has confused the three points of subject matter, disconformity, and infringement.

The Master of the Rolls: We are capable of keeping them clear in our own heads.

Mr. Moulton said this was a very peculiar action in one respect. It practically was an action which right through depended on documents. Of course one was accustomed sometimes to prior user, but there was no prior user alleged, so that the anticipations were documents. Disconformity depended on two documents; but, curiously enough, here the infringement depended on documents, too, and he thought his learned friends had a little forgotten the way in which this action came up. There was a proposal to sell this patent to the public for a large sum. The plaintiffs warned them that this patent was, in their opinion, for an apparatus which was an infringement of the plaintiffs' patent. They brought an action to stop the plaintiffs giving such intimations unless they brought an action. Plaintiffs pointed out that they could not bring an action, because, on their own statement, they never used the machine. Defendants then said they would give an admission that they had used that which was found in Rhodin's specification, and that was the admission on which the action was brought. His learned friends had made a very ingenious argument on questions of particular rates, results of turning round at a foot a second, and everything of that kind; but the issue here was whether the apparatus was an infringement of the plaintiffs' patent. He was going to admit that if there was no distinction between a rotary movement and the to and fro movement, then that there was no practical distinction between the plaintiffs' apparatus and the defendants. Now whether there was a difference between rotary and to and fro, related to disconformity, but did not relate to infringement, because in the claims of the complete specification, plaintiffs clearly claimed rotary motion.

Lord Justice Rigby: We have the models, which we have seen with our eyes. In yours there is a circular or cylindrical space, divided by a partition into two cells. They are equal, you know, and in one of those cells the salt solution is operated, and in the other is not.

Mr. Moulton: Your Lordship is confusing our invention and our drawings. The difference is enormous. You put one drawing as an illustration.

Lord Justice Rigby: Very well. Suppose that that which is an illustration is wrong? Your patent is bad, is it not?

Mr. Moulton: No, not at all.

The Master of the Rolls: Do you say the annulus is no essential part of the defendants' case?

Mr. Moulton: Certainly not. It is not even mentioned in their specification. It is only shown in the drawings.

Mr. Terrell: It is point blank claimed.

Mr. Moulton: No, what had been done before. People had got the idea of electrolysis into what I may call an absorbing cathode, a cathode which, instead of leaving the deposited metal on it, as in silver plate, sucked it in mercury. When they have once got it into that state, if they had paused there and stopped the current, this is a very unstable absorption in the presence of the liquids out of which it was driven, and it would have undone the work. More than that, if you go on loading, you are changing your cathode from a thing that is pure mercury with an avidity for the metal into what I might call gorged or loaded mercury, which has a less appetite. Consequently, in the same way as we find in everything—a partially-satisfied man has not the appetite that he had when he began to eat.

Lord Justice Rigby: Is not that gorged mercury more useful for this process than a moderately charged mercury?

Mr. Moulton: It is more useful in this way that gorged mercury yields up its charge when you have taken it away to a place where you want it to yield up its charge much more easily. In loading cell you get on best when you have got hungry unloaded mercury. As you pile it up it gets less avidity for the metal, and that you feel by finding you have to use more electrical force to drive it in. On the other hand, if you take the first moment when it takes so eagerly and draw the mercury off, that which it took eagerly it yields up reluctantly.

Lord Justice Williams: Is it quite true to say the more electrical force to drive it in? The electrical force decomposes the salt and water, so that you get the sodium in a separate form so that the mercury can absorb it?

Mr. Moulton: Yes.

Lord Justice Williams: Then if that is so, it is not true to say that the electrical current quickens the absorption. What the electrical current does is to increase the amount of material which can be absorbed.

Mr. Moulton: When an electric current passes through it decomposes exactly in proportion to its size. Therefore it is right to say that if the electric current is the same, the amount of sodium presented for this chemical absorption is the same, but the electrical force required to drive that current gets bigger and bigger as the amalgam gets loaded, and that is what is meant in the passages which talk about setting up a counter electromotive force, because mercury which is loaded would, if it was left without a current of electricity, start out backwards, so that it is ready to rush forward, and when you are passing your electrical current through you have got to keep this back before you can get any current through. You are, as it were, pushing up hill. Therefore, the amount of electrical force required to drive the same current gets bigger and bigger as the loading gets greater, because you have got this back spring, which you have to neutralise before you can get any of your current through.

Counsel, continuing, said that Castner, no doubt, marked an important era. Before Castner what they had done was, they had charged their mercury, they had run it off into a separate vessel entirely, and they had treated it there so as to disgorge it, and then they had put it back again. Castner certainly made a very considerable advance in that. Castner took a cell and he divided it in two by a partition that did not go quite to the bottom.

Lord Justice Rigby: But still into the mercury.

Mr. Moulton: Physically he cut it in two by a layer of mercury; chemically he did not cut it in two, but the slowness of action would be too great, and either rocked the thing or put in a paddle which stirred the thing round in order to drive loaded mercury into the other cell. He generally did that by means of a pump. Now, Kellner did something which, so far as the evidence went, was absolutely novel.

He cut his cell in two and got his results by moving one part of the cell relative to the other.

Lord Justice Williams: It seems to me that there is one point that you and Mr. Terrell are absolutely agreed on, that if one wishes to find out what was the novelty in either one of these patents one must not look at anything said in the letters patent about it. You say the great thing, if you look at the Kellner patent, is something which is not mentioned from beginning to end of it. Then I hear Mr. Terrell say the great point about the Rhodin patent is so-and-so. I look at the Rhodin patent and find nothing about it.

Mr. Moulton: You have heard the Kellner patent only when treated with unloving hands. Let me say what I say he did. He was the first person to take an electrolytic cell. Of course, an electrolytic cell is anything which contains necessarily a fluid, necessarily an anode and necessarily a cathode; he took an electrolytic cell containing its fluid and moved it about in a bath of other fluid, carrying its own fluid still, thus cutting in two an electrolytic cell and moving the sides and the contents by themselves for the purpose of getting electrolytic decomposition of these salts.

The Master of the Rolls: He slid the cells over the mercury, instead of sliding the mercury under the cells.

Mr. Moulton: Yes, but whoever slid a cell before containing a fluid in the middle of a bath of another fluid, keeping the two fluids absolutely from mixing, because that is the one thing that is essential. He kept his electrolytic cell, perpetually changing its walls in the sense of perpetually moving it and changing the bottom on which it rested; he moved that about among the other fluid in which he intended ultimately to deposit its contents, and yet he did it without any confusion, without any mixture of the two fluids, and without any destruction of the separate and independent action of an electrolytic cell. Now, with regard to subject matter, about which there has been a long argument, Kellner's invention was a thing which unquestionably possessed subject matter; it was a way of doing something which was by no means obvious, and which gave to the public the choice of getting this alteration, by which I may call mechanical movement of rigid structures instead of fluid movement, that is, by operating on the fluid. They cannot effectually dispute utility for this reason. I am not talking about Kellner's way of applying it, but if I am right in saying that Kellner was the first to do that at all, then that idea, that proposal, and that invention is clearly one which you cannot say is not good subject matter on the ground of utility, because we have an instance of it in this to which the defendants attach so much value.

Lord Justice Rigby: You may be perfectly right in all that you say so far, but if you choose to put into a patent something entirely different you may invalidate the patent.

Lord Justice Williams: The difficulty that your argument seems to overlook is this: Your patent has never been commercially tried.

Mr. Moulton: No.

Lord Justice Williams: I am not sure I do not know whether it would be a success if it were tried, or whether it would not; but you have already told us that it is very much a question of degrees and proportions, and one thing and another. They say, rightly or wrongly, that their Rhodin process includes a variety of functions which are not included in your patent in any way, and no reference made to them. Let us assume for a moment there is no proof that your machine would work commercially, and supposing we are satisfied upon the evidence that their machine plus these differences will work efficiently commercially, would you be entitled to judgment under the circumstances?

Mr. Moulton: Competitive utility is not the test of utility. We gave by our invention a useful choice to the world by which they could attain this alternation of circumstances by new mechanism, which under some circumstances would be valuable and perhaps under others would not. Now, if we have done that and their patent —which I do not admit—shows how great an advantage can be taken of that, then there is a tributory patent; they are using our invention although they have added to it. They have ploughed with our heifer. I do not mean to say the skill of the ploughman is nothing, but still whose heifer was it?

The hearing was adjourned until Monday.

Monday's Proceedings.

Mr. Fletcher Moulton, continuing his argument on behalf of the respondents, said that the bell-shaped salt charged cells passing over the mercury and penetrating into it caused the mercury to become charged with the sodium and the water in the spaces between the bells made the mercury discharge it, and that being the principle of Kellner's invention, he was perfectly within his right in utilising the nine months allowed between the provisional and complete specification to perfect his invention. It was obvious that it was a fair development of the principle to say in his complete specification that it was easier mechanically to make the mercury go round and round instead to and fro, and he also showed that two of the machines might be moved round one axis. The inventor realised that the same thing might be done by causing the electrolytic cells of the upper vessel to rotate over the mercury as by turning backwards the vessel containing the mercury, and he submitted that there was no more difference between the defendants' apparatus than there would be in two mechanical organs, in one of which a perforated music sheet moved round over the top of the pipes, while in the other the pipes were turned round under a fixed sheet of music.

The hearing was again adjourned.

Tuesday's Proceedings.

Mr. Moulton, proceeding with his argument on behalf of the respondents, said that Castner had got a single rigid structure and they had to see what Kellner did. Kellner taught the world a way of doing something which no one had thought of before. As to the issue of disconformity, that which was described in Kellner's complete specification, was, so far as the electrolytic action was concerned, nothing more than the working out of the original idea described in his provisional specification—that was to say, taking his electrolytic cell and moving it about or keeping the cell still and moving about the vessel containing the mercury. That was not a departure in any way from the original idea, but merely a development which the inventor was entitled to make. The true invention disclosed in the provisional specification was a cell in two parts and a bottom movable with regard to the top, so as to bring the mercury alternately under the action of the salt and water and of the water. As to the point of novelty, taking the extremest form of Kellner's apparatus, the form nearest to Castner, viz, that in which the compartments were still, and the vessel containing them rotating, it would be seen that Castner got a rigid cell, and no bells in the containing vessel, and the only thing he did was to move the mercury round on the stationary bottom. If the bottom were cut off and put into a larger vessel, and the inner vessel had divided compartments, the bottom being movable with regard to the top, that would make Castner's apparatus like Kellner's. He submitted that Kellner had not claimed anything that was not new, but if he had overlapped anything that had gone before he must submit to a limitation of his claims in that respect. Kellner's apparatus would do its work if the mercury was frozen, and he did not think he need trouble himself about anything that moved the fluid mercury relatively to its containing vessel in the only way that a fluid could work. Whatever amount of rotary flow there might be in Kellner or Rhodin, both considered that rotary flow not only as not essential, but not advantageous, and both of them tried to check it as much as they could. The question of something quite different from rotary action, such as agitation and the inward and outward current, raised other issues.

Lord Justice Rigby: That is for the purpose of churning it.

The Master of the Rolls said he understood it was agreed that the defendants' apparatus, which had not yet been at work, was to be constructed according to their specification. The language of the specification might be open to criticism, which might turn out to have no application to the actual working.

Mr. Moulton said that on the question of infringement, what was intended by Rhodin and how was it intended to work?

Lord Justice Rigby did not think that mattered much.

Mr. Moulton said in Rhodin's there was a vessel gliding over mercury which both Rhodin and Kellner took pains to keep still. It was in fact Kellner and he might have sold Rhodin for Kellner. All the forms of action in Rhodin were essential to Kellner. If in the course of four years Rhodin had learnt that he ought to move more quickly, surely that did not effect the fact that he was taking the plaintiffs' mechanism and obtaining the same results that the plaintiffs must get, and the learned judge in the Court below came to the conclusion that Rhodin was but a description of what Kellner was. If the plaintiffs had got a valid patent, it appeared to him there could be no doubt but that Rhodin had used their invention and their apparatus—for it was a claim for apparatus—and was proposing to utilise it in the same way. That the defendants had used a larger containing vessel, and thus got a larger wall space, was immaterial, the amount of decomposition being proportionate, not to the water space, but to the electric current, and if there was vertical churning, that would take place whatever the size of the vessel.

Mr. Bousfield, Q.C., followed on the same side, and the hearing was again adjourned.

The hearing was concluded on Wednesday, and judgment reserved.

Cooper v. The Electric Installation Company.

On Friday, March 3rd, Mr. Justice Kennedy and a jury, sitting to take commercial cases in the Queen's Bench Division of the High Court of Justice heard the undefended action, Cooper *v.* The Electric Installation Company. Mr. Sinclair Cox appeared for the plaintiff.

Counsel said that in this case the plaintiff was Mr. H. H. Cooper, an electrical engineer, and the defendants the Electrical Installation Company, who were conspicuous by their absence. Plaintiff had invented several electrical appliances. With respect to four of these the jury would be asked to give an opinion. In the year 1894 Mr. Cooper entered into the employ of the defendants, a company of electrical engineers concerned with the manufacture and application of electrical appliances. An agreement was entered into with regard to which plaintiff now claimed damages for breach of contract. There were four electrical appliances of which the plaintiff was the inventor. They were only partly protected under the Patent Act. When plaintiff entered the service of the defendants they took over these patents.

Mr. Justice Kennedy: Is there any question for the jury?

Mr. Cox: There is the question of damages. They are mainly under the heads covered by paragraph 2 of the statement of claim.

Mr. Justice Kennedy: Would not your best course be to refer the case?

Mr. Cox replied that there were four main heads of damage. There would have to be an account of reference supposing it was considered worth while to pursue one of the accounts against the company. The defendant company adopted the device of reconstruction which they thought protected them for what plaintiff sought to recover. So far as the second point was concerned the defendants had agreed to pay some duties and fees for keeping up the patents. That they had not done. Two of the patents they allowed to lapse, and with respect to the remaining two they gave plaintiff notice that they did not intend

to keep the agreement. But they did not give the proper notice provided by the agreement. Plaintiff kept one patent alive, but did not pay in respect to the other. That one was the arc lamp which required a good deal of capital to keep it up. Instead of giving six months' notice they only gave three days, and never handed the patent over. On July 28th, 1897, they wrote to plaintiff pointing out that the patent required renewal, but they did not propose to pay the fees.

Mr. Justice Kennedy: All you claim is certain alleged damages, I don't see what your damage is.

Mr. Cox: Defendants did not do their best to promote the inventions as they promised to do. Defendants were not to invent anything which might tend to supersede the plaintiff's. It was necessary for the utmost good faith on the part of the defendants. Plaintiff left the employ of the defendants in November, 1894. Between that time and the agreement of July, 1894, and the final repudiation in July, 1897. This was what occurred: of the three patents, two were allowed to lapse. The arc lamp and the wall plug were in existence in July, 1897. Plaintiff was entitled to damages against the defendants because they did not promote the manufacture and application of these inventions according to the agreement. They went further, and actually promoted and supplied other inventions competing with these. It would be for the jury to assess the measure of damage. The Electrical Installation Company adopted the familiar device of going into liquidation and reconstruction. They reappeared as the O'Brien Company; at the same time the patents were also transferred.

Plaintiff was called and said he was an electrical engineer, and the inventor of the four patents mentioned in the agreement of July, 1894. That agreement he now produced.

The officer of the Court here pointed out that the agreement was not the original but a counterpart. The document lacked authority as it had not the proper stamp.

The hearing was therefore adjourned for the rectification of the document.

BUSINESS NOTICES, &c.

"Beacon" Resistance Material.—Messrs. W. N. Brunton & Son, of Musselburgh, send us a circular showing results of tests upon their "Beacon" high resistance material. We understand that wires covered with this material have been in use in America heating electric tramcars for over three years, and they are to-day as tough as ever, thus showing that the Beacon material does not become cold brittle. The recent tests, some of which were made by the Electrical Standardising, Testing, and Training Institution at Faraday House, show the temperature coefficient as 0·0007, the specific gravity 8·1, specific resistance 85·13 at 20° C. The resistance of "Beacon" wire is claimed to be approximately 51 times that of copper. The makers say that it can be heated to 650° C. without fear of injury, that it does not lose its springiness when wound in a spiral, is easily hard soldered, and does not deteriorate in open or damp situations. Messrs. Brunton are also manufacturers of specially tempered armature-binding wire, and specially tempered music wire for mechanical purposes, as well as makers and drawers of iron and steel special sections.

Chatham Electrical School.—At the Electrical School connected with the Chatham School of Military Engineering, situated at St. Mary's Barracks, Quartermaster-Sergt. Carter, Royal Engineers, has been appointed as Sergt.-Major, instructor in electricity, he succeeding Sergt.-Major Urquhart.

Correspondence Tuition.—The International Correspondence Schools of Scranton, Pa., America, owe their rise to the desire of coal miners for assistance in preparing for the examination for better positions as foremen, &c., according to the enactments of the mining laws. Obviously a system of tuition by correspondence had the great aid of practical experience on the part of the learners. Miners taking the lessons would have before them every point dealt with in their lessons. The *Colliery Engineer*, the leading mining journal in America, gave great assistance to miners by a system of correspondence in its pages for the special use of those preparing for examination under the provisions of the Act. Finally, this department of the paper grew too big, and a regular system of instruction by means of a series of instruction papers was inaugurated. In the first year over 1,200 students took the coal mining course, and now the schools comprise a course in mining, chemistry, steam, electricity, civil engineering, mechanics, architecture, plumbing, &c., as well as in English and mercantile subjects. Instruction is by a series of instruction papers, each complete in itself, and properly consecutive upon the previous papers. These papers are worked out from text-books and periodical literature, supplemented by the experiences of the compilers. Of these papers 216 have now been prepared at a cost of £50,000, and they are issued in limited editions and continually revised and modified to meet difficulties. All difficulties which are encountered by students are noted and corrected by suitable explanation or revision. A question paper accompanies each instruction paper. This is answered and mailed to Scranton, examined, and corrected in red, with suggestions by the examiner. No student is considered to have mastered a paper until he has secured a value of 90 per cent. A student receives two papers. On sending in No. 1 complete he receives No. 3 and so on in order, having always one paper by him. Blank forms are provided to be filled out when a student meets with difficulties. Immediate replies are sent to these. Every care is taken to keep touch with students and the weaker ones are cared for by one special instructor whereby their peculiar idiosyncrasies are better appreciated, and so they are encouraged. The full mining course costs £12, and this includes a set of bound volumes of the papers and all postage one way. There are at present employed on the work 50 engineers, and the success has been very great, and is universally admitted to be so, though the whole undertaking is a commercial one. The success is attributed to the care taken in the preparation of the papers and the clear manner in which the subjects are presented, and to the fact that the students are mostly men hard at work and determined to get value from their fees. This induces them to stick to their study. At the same time they have practical experience and actual facts before them to serve as object lessons. The schools in fact teach workers, they do not attempt to make a general of every common soldier.

Directory.—"The Export Merchant Shipper's Directory" for 1899 is now before us. This is the 34th year of publication, and the continual growth of the various sections has now made it necessary to reset the book from cover to cover in a smaller type to prevent it becoming too bulky. A directory of this kind must be of considerable service to merchants and exporters generally. The publishing office is 160A, Fleet Street, E.C.

Recording Instruments.—We illustrate below one of Messrs. Elliott Bros. station pattern recording instruments, which is enclosed in a cast-iron case suitable for affixing to a wall. All the firm's recording instruments use their standard system of paper strips. The instruments are constructed to record on long bands of paper, which are unwound off a spool by the clock, and paid into a space in the lower part of the case. The paper is specially prepared in lengths of 65 feet, and holes are punched down one edge at a uniform distance of half an inch apart; these engage on pins in a wheel driven by the clock, so that the movement of the paper is very definite and accurate. Unless specially required, the rate at which the paper travels is 1 inch per hour, but a gearing can be supplied so as to use the same clock and paper to enable the latter to travel at 3 inches per hour. For other cases (arc lamp testing, &c.) instruments are arranged for a rate of 6 inches per hour; but for special purposes they can be supplied with the clock movement modified, *i.e.*, the escapement is replaced by a small revolving fly, so that the speed of travel of the paper can be increased up to 6 inches per minute. Instruments having this rate are useful for testing governors of combined plants and motors under varying loads. They have been supplied for tests in tramway stations and electric tramcars. A length of about 5 inches of record is visible through the front window of the case. The record paper is not wound upon a spool after passing under the pen, so that a length of it may be examined, or lengths may be torn off at any time. In the case of the quicker rates of paper speed, a slot is cut through the lower part of the case, so that the record strip is paid out quite freely, and may be caught up in any convenient way in a box or basket under the instrument case. The clock has a strong, well-made movement, capable of being accurately regulated. The recording pin consists of a very light removable nib, hanging in a forked piece on the end of the moving arm.

Portable Pattern of Recorder.

Announcements.—Mr. Alexander Hawkins (ironmonger), of London Road, S.E., is branching out into electric lighting and other electrical work.

Mr. Henrich A. Brandt has opened offices and factory at 33, Minories, E.C., where large stocks of every description and quality of mica and micanite will be held.

Auction Sale.—Messrs. Wheatley Kirk, Price, and Goulty are instructed by the General Electric Company to sell by public auction on March 22nd a collection of electrical fittings and appliances, slightly soiled by the recent fire at the company's works. For particulars *re* catalogues, &c., see our "Official Notices" this week.

Changes of Address.—The San Paulo Gas Company, Limited, will on March 13th remove its offices to Nos. 1 to 4 Broad Street House.

The Lancaster Electrical Fitting Company have just removed from Thurnham Street to more central premises in Lancaster.

The editorial offices of *Science Abstracts* have been removed from 66, Victoria Street, to 82, Victoria Street (Grosvenor Mansions), S.W.

Messrs. Joseph Breeden & Co., Ltd., of Birmingham, electrical fittings manufacturers, whose London agent is Mr. W. G. Lucas, announce the removal of their London showrooms from 90, Hatton Garden, E.C., to larger premises at No. 83 in the same thoroughfare.

Dissolutions of Partnerships.—Messrs. James Clements and H. B. Dix (Clements & Dix, steel, iron and metal merchants, Newport, Mon.), have dissolved partnership by mutual consent. Mr. Dix retires from the business, which will be continued by Mr. Clements who will attend to debts.

Messrs. A. Costar & C. Martin (Costar & Martin, electrical engineers, 37, Broadway, Deptford, and 10, Church Street, Croydon), have dissolved partnership. Debts will be received and paid by Mr. Martin, who will continue the Deptford business, Mr. Costar will continue the Croydon business.

Messrs. W. R. Snetzler and A. Pearse (Snetzler & Co., mechanical and electrical engineers, Little James Street, Gray's Inn Road), have dissolved partnership.

Inverness.—Messrs. P. C. Middleton & Co., Limited, have secured the contract for the lighting of the Inverness Music Hall mentioned last week, and will supply current from their own lighting plant.

Liquidation Notice.—Creditors of the Northern Counties Electric and Motor Company are to send particulars of their debts or claims, &c., to Mr. J. Robinson, Nook Lightcliffe, York, liquidator, by April 14th.

Municipal Trading.—In the House of Lords on 3rd inst., the Earl of Wemyss presented petitions against clauses in private Bills respecting municipal trading. He explained that the petitions numbered 142, from different parts of the country, and they came from chambers of commerce, gas, water, and electric lighting companies, employers of labour, property owners, ratepayers, and traders. One of the most important was a petition presented to both Houses of Parliament by the Society of Arts. The question of municipal trading had been before that society, and the Attorney-General was in the chair on one occasion when a paper was read showing the dangers likely to arise to the ratepayers and the public from such trading. By way of illustration he showed that an electric patent, for example, might be purchased by a municipality, and a large amount of money spent upon bringing it into use for the benefit of the ratepayers. Shortly afterwards, however, it might be found that another invention was better and of more public utility, and the result would be that the money expended by the municipality on the prior invention would be rendered worthless. Thus the great evil of municipal and State trading would be the checking of private enterprise and the progress of invention, being at the same time a hindrance to national progress. The petitioners proposed that all Bills containing a manufacturing and selling clause should have their powers suspended until there had been a full inquiry into the whole question of municipal trading. He was glad to see that, as soon as the Chairman of Committees in their Lordships' House noticed these clauses in Bills, he struck them out, thus acting wisely, as he believed, in the public interest; and he believed that Mr. Lowther had followed the same course in the other House. There was no danger from these Bills this year, but still the principle remained; and he asked, says the *Times*, that there should be a full inquiry on the subject either by Royal Commission or by a Joint Committee of both Houses of Parliament. The petitions were presented at the table.

New Branch.—W. T. Henley's Telegraph Works Company, Limited, have opened a branch office and warehouse at 30, Mosley Street, Newcastle-on-Tyne, under the management of Mr. W. Odgers, who has been in the employ of the company for many years. A large stock of wires and cables is kept there.

Smoke Nuisance.—At the Westminster Court on Tuesday, the Westminster Electric Supply Corporation was fined £10 and costs for causing black smoke to issue from their works in Millbank Street, S.W.

Stockport Gas Engines.—The London County Council have just placed an order for four 68-brake H.P. gas engines for the electric lighting of the Victoria Embankment and Westminster and Waterloo Bridges, with Messrs. J. E. H. Andrew & Co., Limited, Reddish, the makers of the "Stockport" gas engine. The Royal Agricultural Hall Company, Limited, Islington, have also just placed an order with Messrs. J. E. H. Andrew & Co. for a 120-brake H.P. engine, this making the sixth large "Stockport" gas engine supplied for this installation.

Theatre Lighting.—Mr. G. E. Cockburn, of 35, Great Poulteney Street, W., has secured the contract for the electric lighting of the Lyric Theatre, Shaftesbury Avenue, W.

ELECTRIC LIGHTING NOTES.

Aberdeen.—The accounts for the electricity undertaking for the year ending December 31st show a deficiency of £126 10s. 8d., which has been charged against the reserve fund. For the first six months of this year the charges are to be 6d. per unit for the first hour daily and 3d. after, and power 4d. and 1½d. per unit respectively.

Barking.—Applications for current are coming in so rapidly that the Council has decided to purchase another set of generating plant.

Bangor.—In connection with the new electric light installation at Bangor, it is reported that a peculiar *contretemps* has arisen—that amongst the guarantors of a bond safeguarding the town against financial loss to the extent of £650 per annum for five years are a number of members of the City Council; that counsel's opinion has been taken, with the result that the bond is not considered a legal instrument; that another counsel, consulted by one of the members of the Corporation, has further expressed the opinion that all the members of the Council who signed the bond were thereby disqualified from being members of the Council, and that as a consequence a new election of the Council will have to take place. It was stated that when the position of affairs was communicated on Thursday night to the Lighting Committee, considerable consternation was created.

Bath.—Some days ago Mr. R. Hammond appeared before the Electric Lighting Committee and informed the members as to the results of the tests he had made on the new machinery at the works. He said that the engines had carried an emergency load of 15 per cent. running continuously for two hours, but there were a few minor defects to be remedied. The old engines were veritable coal-eaters and it was satisfactory to report the new engines were most wonderful in their economy. They were surprised because, whereas they provided eight tons, they only used on the tests a little over three. That meant an increased load would be carried on a lower coal bill than last year. Mr. Hammond also alluded to the results of the tests as to steam consumption. He fixed in the specification 28 lbs. as the figure to be guaranteed, but offered a bonus of £150 for every pound or part of a pound below 26—a figure which had never before been reached. As the result of the tests he was in a position to say the engines running at their works were the most economical which had ever been tested on electrical work. The first engine gave a steam consumption of 22·78 lbs. and he was astonished at the result, while the duplicate plant, which had not been running so much, gave 23·42 lbs. These figures told directly on the coal bill, and as a result of these tests the contractors were entitled to be paid bonuses to the amount of £800 for this steam efficiency. Mr. Tonkin asked how many tons of coal would be saved as a result of their having offered these bonuses. Mr. Hammond said that depended on the extent to which they worked the plant; but he should put it at £400 a year compared with their former coal bill. Mr. Bush agreed that the payment of the £800 would be a splendid investment, but had they not something to set against that in the way of fines on the makers for non-delivery, as the result of which they had been so handicapped. Mr. Hammond, who spoke with diffidence in the presence of the reporters, said he was taking a strong line in the matter on the Committee's behalf. The matter of penalties was receiving his attention, and would be dealt with in the final statement. Half the bonus, however, went to the makers of the engine, and he suggested the extent to which damage claimed by the Committee should be set off against the bonus, should be left to the Works Committee, with whom he would confer. This was agreed to. In regard to Mr. Hammond's position as consulting engineer, it has been arranged that he should retain his responsibility for the work already carried out, until such time as he gave his final certificates for the payments of balances due to contractors; that he should receive the commission upon the sum of £33,872 as agreed, and that all future extensions should be under the absolute control of the Electric Lighting Committee and the city electrical engineer. Mr Hammond agreed to conduct the approaching application before the Local Government Board for further powers to borrow money. The electricity works accounts for the year 1898 show that £51,561 has been expended on capital account, that the year yielded a revenue of £7,112, while payments, including repayments of loans and interest, came to £125 more, resulting in a loss to that extent. Mr. Metzger said that reducing the price of current cost £297 18s. The price for lighting the Guildhall is to be reduced to 4½d. per unit, provided all the municipal buildings are electrically lighted. The Electric Lighting Works Committee had before it a report by Mr. Metzger suggesting extension of the mains in various streets, also an increase in the number of public electric lamps in place of a number of gas lamps. The result of the extensions would be that a present candle-power of 3,122 would be substituted by one of 140,000. The revenue per annum would be £1,750, as against a present cost of gas of £686, but against this must be deducted the allowance of 17s. 6d. per lamp for the existing 87 arc lamps—£76 2s. 6d. The capital outlay would be £6,530, giving a revenue of 26¾ per cent. The cost to the city for lighting the proposed additional 70 arc lamps will therefore be £1,673 17s. 6d., as against £686 at present paid for gas, nearly two

and a half times as much, but the candle-power by electricity will be 40 times greater than that obtained from gas. It was recommended that the low tension mains be extended into various streets for private lighting. It was stated that the outlay for the proposed substations, low tension cables, feeding same, and all necessary switching gear would be £2,500. For all the above extensions the plant at the station would be sufficient. After discussion the report upon the subject of the main extensions was referred back to the Works Committee for further consideration, and a further report and estimate of the cost of lighting the proposed streets and including the Upper Bristol Road with incandescent electric lights will be submitted. The total number of lamp connections at the end of 1898 was 17,802 8-C.P., supplied to 221 consumers with 234 installations.

The engineer reports that within the last six months the new connections have represented about 1,600 lights.

Beckenham.—The Urban District Council, on February 20th, adopted a scheme for the electric lighting of the parish. They have entered into a contract with the British Insulated Wire Company, for that company to provide the initial installation for the sum of £25,054, the Council on their part to erect the necessary buildings and chimney, and also dust destructors; and for this purpose the Council will raise a loan of £37,000 in the usual manner. For the first 12 years the company are to run the station at their own cost, supplying electricity at not exceeding 6d. per unit to all would-be consumers, and undertaking to destroy all the Council's refuse free of charge. They are further during the five years to pay the Council the amount of the sinking fund and interest on the whole loan raised for the undertaking. All the plant, as well as the destructors, is to be handed over to the Council at the end of that time in perfect condition. It is expected that electric light will be supplied to Beckenham not later than Christmas next.

Belfast.—On the advice of the Electric Committee, the Corporation has resolved that the present system of charging, as approved by the Corporation, be adhered to; but the time for which a consumer is charged at the rate of 7d. per unit be reduced from 1½ hours to 1 hour per day.

The electrical engineer recently suggested to the Electric Committee that, in view of the explosions which had occurred in the electric conduits, it would be advisable to consider the question of ventilating shafts being connected with the conduits.

Bermondsey.—In submitting the estimates for the ensuing year at a meeting of the Vestry on Monday evening, Mr. Bristow stated that an expenditure of £500 would be incurred in connection with the promotion of the Vestry's electric lighting order in the House of Commons. It was also expected that, when they went to the House of Lords, they would also have to fight, and that would cost the Vestry another £500. A further item included in the estimates was £500 for the wiring of the Town Hall, which work, the speaker stated, was to be undertaken simultaneously with the painting and decoration of the building.—Mr. Cox submitted the report of the Electric Lighting Committee, stating that from the minutes of the London County Council it appeared that the latter had decided to ask the Board of Trade to insert certain amendments in the Vestry's provisional order, but that the amendments were not specified in the minutes. The Committee did not propose to take any action, and the Vestry approved this course. A small committee was appointed to attend before the Board of Trade in support of the Vestry's application for a provisional order.

Bethnal Green.—The Vestry last week resolved to oppose the County of London and Brush Company's Bill. It also refused to allow several private firms to obtain current from other parishes, or to lay electric mains between their branches.

Bettws-y-Coed.—The committee of residents which recently inquired into the question of electric lighting has reported that the only available water supply for a local installation was the Swallow Falls. This could be carried out by utilising the dam above the falls, and running a length of pipes from thence along the ground between the main road and the falls for about 1,000 feet, and then dropping to a spot immediately below the falls; an installation could be put down, including building and the "wiring" of the district, for less than £2,000. They believed that, by using the water-power in this way, the electric energy could be supplied to consumers at 5d. per unit, with a substantial margin of profit, if the Earl of Ancaster would grant the necessary permit at a nominal rent. The report further advised the ratepayers to authorise the Council to employ Messrs. Gilbert, Gilkes & Co., Kendal, to report upon the scheme. After discussion, the District Council has decided to defer the question for the present.

Birkdale.—The Lighting Committee advises the Council to proceed to carry out the powers obtained under its 1898 provisional order.

Birmingham.—The Estates Committee have submitted a scheme to the Corporation for the substitution of electric lighting for gas in that part of the Council House under their control. The report goes into particulars as to the kinds of fittings for the various rooms and corridors. There would be 853 lights in all, and the tender of the Birmingham Electric Supply Company (£1,774) has been accepted.

Broadstairs and St. Peters.—The District Council has sent to the Board of Trade a note of various amendments and additions which it suggests for the provisional order applied for by the Isle of Thanet Light Railways (Electric) Company.

Calcutta.—A Calcutta paper says that the dynamos at the electric light station were expected to be running at the end of February. Mains were being laid, and the capacity of the central station is about 1,500 H.P. A good deal is expected to be done in the way of driving fans electrically.

Canterbury.—The electrical engineer is to buy 20 electric meters. The electricity works open to-day.

Cheriton.—The District Council gives notice in the *London Gazette* of application to the Board of Trade for proposed amendment of the draft of its provisional order.

Colchester.—The Electric Light Works Committee has reported that the question of providing additional plant for the winter of 1901, and the extension of mains had been considered. The borough surveyor has been requested to prepare a detailed report, together with an estimate of the cost.

Crewe.—The Council has adopted a report of the Electric Lighting Committee, suggesting that the area of lighting should be extended so as to include West Street.

Croydon.—The success of the municipal electricity undertaking is maintained. Mr. Cook, printer, of High Street, is installing a motor for driving his machinery.

Darwen.—It is stated that the new electricity works will be ready by June. An estimate has been made by the electrical engineer, who reports that during the first year there will be a probable loss of £461, and in the second year £79.

Dorking.—Mr. W. H. Trentham's report on electric lighting has been received, and is being circulated among the members of the Council.

Dublin.—The offer of a syndicate to take over the electric lighting undertaking of the Corporation, and extend it by spending £380,000, came before the Council last Monday. A letter was then read from the syndicate, which is named "The Municipal Industries Syndicate, Limited," 37, Great Tower Street, London.

Dundee.—The Works Committee of the Dundee Harbour Trust is considering a report by its engineer on the proposed electric lighting of the harbour. He estimates the cost of a complete installation at about £6,000. He advises a complete installation in preference to a few isolated lamps. He draws special attention to the great service that electric lighting would render to vessels at night time. He awaits the Trust's instructions to go further into the matter and prepare specifications, &c.

At a meeting of the Tramways Committee last week it was reported that the electricity rental for the year now current amounted to £4,808 0s. 5d., being an increase of £985 1s. 3d. on the previous year. The number of units generated during the past month was 72,745, the number of lamps connected 1,094, and the coal consumed 298 tons.

Plans for proposed extension of the electric lighting station were last week remitted to the city architect for him to obtain tenders.

Ealing.—The Electric Lighting Committee has reported to the Council on the applications from the District Councils of Acton and Hanwell for a supply of electricity from the Ealing station for lighting purposes. The committee is asking for copies of provisional orders, and when these are received will go into the matter. The committee has had communications from several firms who tendered for the new plant, and has now recommended that the tender of Messrs. Siemens Bros. (Belliss engines) be accepted. The mains are to be extended through Carlton Road at a cost of £400.

Eccles.—Mr. L. H. Coombe, who was only recently appointed electrical engineer to the Corporation, has felt himself compelled to offer his resignation to the Electric Lighting Committee in consequence of the censorious remarks made at the last Council meeting against him and his staff. The resignation has been considered, and the chairman, Alderman Kendall, has, according to the local press, been deputed to wait upon Mr. Coombe and request him to withdraw it. The committee state that as the works have not yet left the contractors' hands they cannot take the view that Mr. Coombe can be held answerable for the defects which had been found in the public lighting cables.

Ecclesall.—The Board of Guardians having received tenders for the electric lighting of the new hospitals, has appointed a committee to follow up the matter.

Freshwater (I.O.W.).—Representatives of the West Wight Electric Supply Company attended a parish meeting last week to explain the applications of electricity. A resolution was passed to the effect that Freshwater and Totland should "support some sound scheme for supplying those districts with electricity."

Gateshead.—The Parliamentary Committee has reported to the Council on the proposed amendments to the draft Bill of the Tramways Company. The committee want certain agreed terms *re* electric lighting details inserted in the provisional order, but the company argue that they should be inserted in the agreement between the parties. The Council says that it will withdraw consent unless the terms are incorporated in the order.

Glasgow.—A Glasgow paper says that the Corporation and the Kelvinside Electricity Company do not yet see eye to eye in their negotiations, for the latter are persisting in their applications to the Board of Trade for the provisional order held by Partick for the lighting of the burgh by electricity. A commission has been appointed by the Board of Trade to hold an inquiry on the subject on 16th inst.

Hammersmith.—Last week the Electric Lighting Committee reported that the number of applications received for private lighting is 301 for a total of 21,570 lamps of 8-candle-power, the number of consumers already connected is 254, with 17,768 lamps, and the maximum number of lamps alight at one time is 16,713 (including street lighting).

Hampstead.—The Vestry has decided to inform the London County Council that it is prepared to take up the loan of £2,560 for the additional arc lighting scheme (repayable within 42 years, at £3 2s. 6d. per cent.), and as regards the sum of £1,860 (representing the cost of installing the electric light) the Vestry agrees that the cost of all plant and machinery covered by the loan which it may be necessary to renew or replace during the currency of such loan, viz., 42 years, shall be defrayed out of a sinking fund to be provided for that purpose, or out of maintenance account.

During the past month 1,216 8-C.P. lamps have been connected, making a total of 79,307. The water-softening plant at the central station is to be increased at a cost of £300 to treat 4,000 gallons per hour.

Harrogate.—The Electric Light Committee have recently put in, and got into working order for this season, a new 600-H.P. plant, and 600-H.P. boiler, which increases the capacity of the station by another 10,000 lights and practically doubles it. For street lighting the Corporation are fixing up 30 arc lamps to be lighted by Whitsuntide.

Hereford.—The Board of Trade have intimated their approval of the scheme for the installation and distribution of electric light in the city, and the committee hopes to have the order completed within a few days.

High Wycombe.—On 1st inst. the new electricity works put down by Messrs. Edmundsons' Electricity Corporation were publicly inaugurated. We shall describe these later.

Hornsey.—The District Council has not yet put its provisional order into force, pending the result of incandescent gas experiments, and the Westminster Electric Supply Corporation recently wrote offering to take over the powers. The letter has been acknowledged, and the Lighting Committee has the matter under consideration.

Hull.—On 28th ult. a Local Government Board inquiry was held with reference to the Council's application for powers to borrow £16,000 for electric lighting purposes. The chairman of the committee (Alderman Skinner) gave general details regarding the progress of the undertaking, and Mr. Barnard, the electrical engineer, gave particulars of the capacity of the plant at the two stations. The capacity of the plant at first laid down was sufficient for a maximum of 10,000 lamps burning at once. This was increased in 1894, and again in 1895, bringing the capacity of the Dagger Lane or older station up to an equivalent of 22,000 lamps of 8-C.P. burning at once. The Sculcoates Lane or new works opened in October, 1898, and started with a capacity of 14,666 8-C.P. lamps, which was now being increased to 29,666 such lamps. The total capacity of the present works was:—Dagger Lane, 22,000; Sculcoates Lane, 29,666; total, 51,666. There were, however, equivalent to 69,350 8-C.P. lamps connected to the mains, and in addition notice had been received of about 5,800 such lamps now being fitted up. The present plant would, therefore, be clearly inadequate to meet the demands in the near future, unless supplemented by considerable additions. Numerous requests had been, and continually were being made for an additional supply of current to the area inside the docks; and it was therefore proposed to erect a new sub-station in Osborne Street to relieve the Dagger Lane works of the supply to consumers outside the docks, leaving those works free to deal with the additional demands inside the "old town." It was now proposed to extend the plant at the Sculcoates Lane generating station, and to put down an additional sub-station at Osborne Street, and provisional contracts were now being arranged for plant, buildings, &c. The estimate for machinery was £9,952; mains and connections, £5,108; buildings, £640; contingencies, £300; total, £16,000.

Ingleton.—With respect to the recent public meeting, at which electric lighting was favoured, a company being afterwards formed to light the district, some of the inhabitants have since expressed the opinion that there will not be water-power enough at certain times to make the electric lighting a success. Another meeting was therefore held on 27th ult., the gas interests being in strong force, but the meeting came to an end without anything being done.

Inverness.—The Inverness District Lunacy Board has decided to introduce the electric light into the district asylum during the ensuing summer. The work is to be carried out under the supervision of Dr. J. T. Bottomley, F.R.S.

Kendal.—At last week's Council meeting the electric lighting question was discussed. Mr. Wakefield moved that steps be taken to apply for a provisional order next autumn, but exception was taken to this because a sub-committee was already considering a report by Messrs. Handcock and Dykes, and proposed visiting neighbouring towns where electricity works are in operation. It was resolved to allow the sub-committee to carry the matter through.

Kingswood.—A large meeting of ratepayers has approved of the action of the District Council in regard to the contract with the local electric lighting company, the Council having, as already stated, entered into a contract with the gas company.

The whole undertaking of the Electric Light Company came under the auctioneer's hammer, and fetched a total of £475, the bidder being Mr. J. Pugsley, of St. Philip's.

Liverpool.—The City Council has resolved to purchase land in Lister Drive for the purpose of a new electric generating station, which will be three times the size of the works in Pumpfields. There was objection raised in the Council meeting, but this was classed as "sentimental," and the voting was 64 votes to 17.

Manchester.—At the City Council last week Alderman Higginbottom mentioned a rather awkward matter for the Electricity Committee. They recommended that 3,008 yards of land in the Polygon, Ardwick, should be purchased from Alderman Tunstall at 9d. per yard and 20 years' purchase. It was wanted for the building of cable stores. The Committee had bought a plot of land from Mr. Tunstall and his son for £5,045, this being 1s. per yard and 20 years' purchase. It was surveyed in the ordinary way, and when the purchase was completed it was found the land could not be built upon because a 13 feet culvert ran through it. It was now proposed to use the land first bought for storage purposes, and after considerable discussion the minutes of the Electricity Committee were passed.

Margate.—The Corporation give notice in the *London Gazette* of the intended transfer of their provisional electric lighting order to the Isle of Thanet Light Railways (Electric) Company.

Marylebone.—One of the examiners of private Bills last week had before him the case of the Vestry Electric Lighting Bill. A memorial alleging non-compliance with the rules of Parliament had been lodged on behalf of the Metropolitan Electric Supply Company. The examiner held that non-compliance with standing orders was proved, and that the case would have to be reported to the Standing Orders Committee. The Committee will in due course consider whether or not the standing orders should be dispensed with.

Natal.—Last month the Council considered several reports *re* the electric lighting installation. Applications for connection to the mains have exceeded all expectations, and a jointer has had to be cabled for from Helsby to keep pace with the work. The buildings and plant are to be considerably extended. The borough electrical engineer does not advise the adoption of overhead wires for the extensions, and he strongly emphasises the necessity of replacing the existing overhead wires by underground cables. The overhead wires were put up in the initial stage in order to do things as cheaply as possible. The extensions to private incandescent lighting now proposed will cost £7,013, and the additional arc lighting £1,285, and there are other items which bring up the proposed expenditure to £10,487.

Newport (Mon.).—According to the report presented to the Newport Electric Committee, matters are proceeding most satisfactorily, but it is essential that the extended plant shall be completed as soon as possible. It is hoped that by the end of March the new plant will be laid down as the engines are finished at Leeds.

Northallerton.—A special meeting of the Urban Council is to be held to consider the electric lighting question.

Oldham.—The salary of the borough electrical engineer (Mr. Newington) has been raised from £200 to £250. His duties have largely increased recently. In 1896-7 when the last increase was given the units for the year were 145,004, and in 1898-9 the units produced were 290,104, or exactly 100 per cent. increase. At that time the horse-power was 720, and to-day it is 1,820.

Oswestry.—At last week's Council meeting the committee appointed to negotiate with the Oswestry Electric Light and Power Company, Limited, reported that the company were willing to sell their undertaking to the Corporation, and in accordance with the instructions of the Council steps were being taken to secure the services of an expert to advise as to the value of the concern.

Plymouth.—The Free Public Library is about to be lighted electrically, the contract having been placed with Messrs. Robinson, Sadler & Co.

Pontefract.—The Board of Guardians has adopted a report by Mr. R. Holiday, electrical engineer, advising that a £900 installation be put down for the workhouse, the yearly cost of maintenance (including interest) being £136, as against £233 9s. for gas.

Pontypool (Mon.).—The Council, which has recently had in contemplation a scheme for the lighting of their central streets with electricity, have decided upon the trial of a new gas lamp. Two of these have been fixed in the town, and after the trial of these the Council will decide between gas and electricity. In the meantime the negotiations with the electric lighting company stand in abeyance.

Rhyl.—Last week members of the District Council visited Llandudno to inspect the electric light and dust destructor works.

St. James's, Westminster.—The Vestry at the last meeting were informed by the Parliamentary Committee that they had considered the Bill promoted by the Central Electric Supply Company to construct works in Marylebone, and to supply electrical energy in bulk to, among others, the St. James's and Pall Mall Company. In the opinion of the Committee the Bill is objectionable in principle, and calculated to interfere with the rights of the local authority in acquiring the undertaking of the St. James's and Pall Mall Company at the expiration of the provisional order. The Committee had authorised the vestry clerk to lodge a petition against the Bill, and had asked the London County Council to oppose it on behalf of the local authorities concerned. On the motion of Mr. Van Raalte, the Vestry approved the action of the Committee, and decided to oppose the Bill by counsel in case of necessity.

Salford.—The Town Council last week appointed Messrs. Lacey, Clirehugh & Sillar as consulting engineers for a term of three years, at the rate of 2½ per cent. commission on all capital expenditure in connection with the proposed generating station and the electrical portion of the tramway work, architectural work being excepted.

Seaham Harbour.—The District Council has decided to apply for a provisional order.

Sevenoaks.—The Council has been asked whether it would consent to an application on behalf of a company for a provisional order. The letter has been referred to the Lighting Committee.

Sheffield.—The City Council has decided to extend the electric lighting mains and other works in connection with the electricity undertaking at a cost of £3,583. Eight arc lamps are to be fixed in the vicinity of the Town Hall for public lighting for the sum of £350, this price including cabling and wiring, &c.

Shoreditch.—When the report of the Lighting Committee was submitted to the Vestry on Tuesday by Mr. H. E. Kershaw, an interesting discussion was anticipated on the recommendation of the Committee that the Vestry should approve their action in deciding "to transfer the sum of £1,000 from the profit of the electricity undertaking for the relief of the general rates" during the Midsummer quarter. The recommendation was, however, opposed, and was postponed to a future meeting. It was decided on the recommendation of the Lighting Committee to take the necessary steps to carry out the work of arc lighting in Wilson Street and Paul Street, at an estimated cost of £950, where 20 arc lamps will be required. It was also resolved to sanction an expenditure of £2,750 on the establishment of arc lighting in various streets in the Haggerston district. The number of lamps needed would be about 40, and the streets included in the scheme are Great Cambridge Street and Queen's Road, Haggerston Road, and a portion of Kingsland Road. The Lighting Committee stated that Mr. Newton Russe l, chief electrical engineer, had reported that the new 250 kilowatt set, recently supplied by the Electric Construction Company, coupled to a Belliss engine, had been satisfactorily tested and had been taken over on behalf of the Vestry. The action of the committee was approved. Seven tenders were received for the supply of Powell Duffryn coal for the electric lighting stations during the ensuing year. It was decided to accept the lowest tender, namely, that of Lowther & Cameron, who quoted 19s. 11d. per ton.

Sleaford.—The Urban Council refused to entertain a proposal for the gas company to put in incandescent burners as they had engaged Mr. Smith, of Oswestry, to report on the expediency of installing the electric light.

Slough.—The District Council has received a letter from the Board of Trade with reference to the Council's objections to the granting of the provisional order for the lighting of Slough and Datchet. The Board states that the order will not be proceeded with.

South Shields.—A Local Government Board inquiry was held on 22nd ult., *re* an application from the Corporation to borrow £20,000 for electric light extensions. Mr. Jeckell, the borough electrical engineer, described the plant that it was proposed to put down. There was as usual no opposition. The electric light undertaking has made rapid strides at South Shields within the last 12 months, as the following figures will show:—

Maximum load, February 23rd, 1898	... ...	125 kw.
" " 22nd, 1899	... ...	292 "
Lamps connected, February 23rd, 1898	... ...	5,969
" " 22nd, 1899	... ...	16,514
Output at station, week ending February 23rd, 1893		3,474 units.
" " " 22nd, 1899		11,177 "
Capacity of plant, February 23rd, 1898	... ...	200 kw.
" " 22nd, 1899	... ...	600 "

Units Sold to Private Consumers.

Quarter ending Dec. 31st, 1897,	33,028.
" " 1898,	79,272 = 140 per cent. increase.
Month ending Jan. 26th, 1898,	10,507.
" " 25th, 1899,	28,349 = 169 per cent. increase.
Month ending Feb. 23rd, 1898,	8,254.
" " 22nd, 1899,	25,670 = 213 per cent. increase.

At a committee meeting held on February 22nd, Mr. Jeckell reported on an application from the authorities of the workhouse, which is 150 yards outside the borough, to be supplied with current. Their annual gas bill equals £300. It was resolved that the cables be laid and supply given (with Board of Trade sanction) at the same price as is charged in the borough if they will take it for five years. Mr. Jeckell also reported that he hoped to lay before the Committee a large scheme for cable extensions at their next meeting, as it was most desirable to extend these, especially in view of the fact that the gas company had raised their prices from 2s. 6d. to 2s. 8d. per 1,000 cubic feet. The Sub-Committee have also under consideration the reduction of the price from 7d. and 3d. to 7d. and 1½d., and the adoption of some system of free wiring, which, in view of the increase in the price of gas, the engineer is very desirous should be brought about as soon as possible. Besides the workhouse, there are 2,000 lamps applied for which are not yet connected. An immunity from breakdowns and a price which many people find cheaper than gas has been responsible for this rapid development.

Southampton.—The Borough Council has, on the advice of the Electric Lighting Committee, instructed the town clerk to advertise for tenders for stores for a period of 12 months. The electrical engineer reported that the number of units sold during the month of January was 38,363, being an increase of 50·5 per cent. over the number sold in January, 1898; that an equivalent of 604 8-C.P. lamps had been connected during the month. That the new engines at the generating station were all running; that the supply of alternating current was given from 4 p.m. until daylight; that the automatic stokers had given some trouble, but the parts which required replacing had been ordered from Messrs. Babcock & Wilcox. The question of lighting the whole of the public parks by electricity is receiving consideration, also the purchase of land for extensions to the works. Tenders which have been received for transformers are to be reported upon by Mr. Manville. The Committee is about to consider the question of providing plant for the electric tramways. Alderman Bone proposed the adoption of the report, stating that the only part which required explanation was with respect to the piece of land to enable them to provide storage, adjoining the present works.

Stirling.—The Secretary for Scotland has given the Police Commissioners authority for borrowing the sum of £25,000, being sufficient to cover the estimated cost of Prof. Kennedy's electric lighting scheme for the burgh. The contracts having previously been settled, the work will be proceeded with at once. Under the scheme mains will be laid in the central parts of the town and in a large number of the suburban thoroughfares. For public lighting the Commissioners contemplate erecting 20 arc lamps in the principal streets. The electric lighting station will be situated close to the Caledonian Railway, from which a siding is to be formed.

Strood.—The Chatham, Rochester and District Electric Light Company have extended their main across Rochester Bridge into Strood.

Wallsend.—The District Council will petition in favour of the Electric Lighting Bill of the company, but will ask the promoters to "satisfy the Council as to the practicability of using the refuse of the district for generating power."

West Ham.—The Town Council had a debate of tiring length the other day as to whether Messrs. Ferranti paid the Manchester district union rate of wages. The firm appear to have declared that they are not in the Manchester district, and will not pay the Manchester rate. The tyrannical spirit of the West Ham trade unionists was shown by the decision that if the firm declined to do as they were told, the contract should be again advertised for tender.

Whitechapel.—We understand that the District Board has adopted the recommendation of the Electrical Committee that the amended offer of Messrs. Manlove, Alliott & Co., for the erection of a new destructor for the district, in accordance with the design which has been prepared by them and considered by the Committee, in which certain results have been promised, at the cost of £17,740 16s., be accepted, upon a sufficient agreement being entered into by that firm to guarantee the performance of such results and upon such conditions as the Electrical Committee may approve. It has been referred to the Electrical Committee with power to settle and complete the form of agreement necessary, and to give directions necessary to have such work carried out.

Worcester.—The statement of accounts of last year's working of the electricity department says that the capital account shows a total expenditure to date of £74,397 3s. The revenue account shows gross receipts of £7,154 3s. 8d., compared with £6,291 in 1897, and the expenditure £3,943, compared with £4,096 in 1897. These figures show a gross profit on working of £3,210 10s. 9d., compared with £2,195 0s. 10d. in the previous year. After payment of interest £1,946, and payment to sinking fund £1,724 11s. 10d., there is a net deficit of £460 1s. 1d., compared with £1,474 in 1897. The engineer (Mr. Sutherland) thinks that if the new plant had been completed before the end of the year, and if the coal strike had not added to the cost of coal, there would have been a profit instead of a loss.

Wormit.—The installation of an electric lighting plant by Mr. Alexander Stewart is now about completed. The wiring is confined to the property belonging to Mr. Stewart, which includes about a score of houses. There are also several lamps erected for outdoor use.

Worthing.—The Council, sitting in committee, recently instructed Messrs. Burstall & Monkhouse to prepare plans and particulars to enable that body to apply for a £37,500 loan for electric lighting works. The charges suggested are 6d. per unit for private lighting and 2½d. for public.

York.—The Electricity Committee is to spend £2,000 upon laying a cable in Micklegate, with a view to saving money in the long run.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Behr's Lightning Express.—It is stated that a joint committee for representative men from Manchester and Liverpool is being formed for the purpose of investigating the engineering and commercial possibilities of Mr. F. B. Behr's project. The Corporation of Liverpool have appointed the Lord Mayor, the town clerk, and three other gentlemen to act on such committee.

The Black Country.—Last Friday the Light Railway Commissioners held a public inquiry at Bilston respecting an application by the British Electric Traction Company to construct a light railway in several of the South Staffordshire districts, including Bilston, Willenhall, and Darlaston. The promoters of the railway were represented by Mr. S. Morse, who explained the objects of the application. He said the British Electric Traction Company had acquired the Dudley and Sedgley line, and that the Wolverhampton Tramways Company had made an agreement as to the portions outside Wolverhampton, which, if carried out, would result in the line to Moxley on one side, and to Willenhall on the north, becoming the property of the British Electric Traction Company. It was to the public interest that the application should be granted, and, excepting the Corporation of Wolverhampton, all the local authorities through whose districts the light railway would pass were in favour of the preamble. The Wolverhampton Corporation were promoting a Bill for powers to get local lines and powers for working them, notwithstanding that their capital would be raised on the rates of their town. Wolverhampton's was a dog-in-the-manger policy, and was an illustration of that wish for municipal trading which was so rampant just now, and by which Wolverhampton had been bitten.—Mr. Sellon (engineer to the promoters) described the route of the proposed line. Under the scheme Bilston would be connected with the Wolverhampton tramways; a junction would be formed at the Fighting Cocks, near Sedgley, with the Dudley, Sedgley and Wolverhampton Tramway Company by a light railway along the Parkfield Road to Bilston; and Bilston would be connected with Willenhall. The gauge would be a uniform one of 3 feet 6 inches, and the system would be worked electrically on the overhead principle. The estimate for the construction of the lines was £28,767. There would be no engineering difficulties whatever. With regard to the roads, they would be of the ordinary construction—concrete foundations and granite setts. There would be one or two narrow lines—from Darlaston to Willenhall. Darlaston desired to have certain roads opened, and he did not see any difficulty in that respect.—Mr. Garcke (the managing director of the company) stated that during the past three years negotiations had been carried on with the Wolverhampton Corporation, and he had repeatedly told the Corporation that the company were proposing to extend light railways all over South Staffordshire. He distinctly said the company would make further extensions under the Light Railways Act.—Mr. Brevett, on behalf of Wolverhampton, said that in his opinion it was one gigantic tramway scheme, and there was nothing in the application relating to light railways at all. The company were trying to invade the Wolverhampton area under the guise of the Light Railways Act to construct a gigantic tramway.—The inquiry lasted five hours, and at its conclusion the Earl of Jersey intimated that he would reserve his decision.

Bootle.—The Watch Committee has been in communication with the Liverpool City Council with regard to the ultimate outcome of the negotiations with reference to the adoption of electrical power for tramways traversing the thoroughfares of the borough, and at Wednesday's Council meeting brought forward the following recommendations:—That powers be given to the Council to reconstruct the tramways and adopt electricity; to supply the electric power required for the working of the tramways in Bootle; to inform the Liverpool Corporation that the Council would also be prepared, on the passing of the Bootle Corporation Bill of this session, to supply electric power for the service in Litherland, if the Liverpool Corporation were willing to take the same; to sanction the expenditure of the estimated sum of £13,436 for the station plant, feeders, mains, and overhead construction required for the Stanley Road and Strand Road sections of the tramways and any additional sum that might be approved by the Council; to urge on the Liverpool Corporation the desirability of Strand Road being included with Stanley Road in their present scheme of electric car service; to sanction the employment of Mr. T. L. Miller, electrical engineer, Liverpool, to advise the committee and prepare specifications of the electrical works required, and superintend the erection of the station, plant, &c.

Central London Railway.—It is announced that the Central London Railway (Mansion House to Shepherd's Bush), will be opened for traffic on November 1st. The original date fixed was June, but unavoidable difficulties have caused delay.

Cheltenham.—The Tramways Committee have finally settled the draft provisional order for the proposed light railway, which will run through the borough and up to the top of Cleeve Hill. The Council has adopted the recommendation that the Council support the promoters' application before the Light Railway Commissioners, if Mr. Nevins would give an undertaking to insert the committee's amendments in the order.

Clontarf and Howth.—A commencement has been made with the construction of this electric tramway, which will run partly on the public roads, and partly on a private way. The total length will be 5½ miles. The overhead trolley will be employed. The line may be opened for traffic in the summer.

Colne.—The Town Council recently proposed to obtain powers to construct a light electric railway from Colne to Trawden. Last week, however, the Mayor reported that after several interviews with the promoters, and also with Mr. Pritchard, electrical engineer for the Corporation, the sub-committee had advised the Corporation to enter into an agreement between the company and the Corporation, under which the Corporation would withdraw their application for an order, and support the application of the company. The Corporation had secured most favourable terms, and the interests of the borough were amply safeguarded. The Corporation reserved the right to supply the necessary electrical current to work the railway, and at the same time it was proposed to make provision for supplying electricity to other private consumers as well, at a price which would be advantageous to the Corporation. This arrangement would place the Corporation in the position of being able to supply electricity within the borough on more favourable terms, on account of the large quantity which would be at once on demand. At last week's Council meeting the agreement was sealed.

Coventry.—The Coventry Electric Tramways Company's bye-laws and regulations are printed in the *London Gazette* for March 3rd.

Dublin.—The Dublin and Lucan Steam Tramway Company proposes to lease an acre of land at Fonthill, County Dublin, upon which to build an electric power station.

Dudley and Stourbridge.—Last Saturday the Light Railway Commissioners held an inquiry into the application of the British Electric Traction Company for an order for extensions of the lines already made or authorised. Mr. Morse and Mr. Stephen Sellon explained the proposal on behalf of the company. Lord Jersey, after hearing considerable evidence, said the Commissioners would recommend the order, subject to the widening of Foster Street, Stourbridge.

Dudley and Wolverhampton.—Last Friday the chairman of the Tramways Committee reported that the negotiations between the Council and the British Electric Traction Company had been concluded. The company had agreed to purchase the Council's right of pre-emption, and had undertaken to lay down and equip with electrical energy the existing tramways within the next two years.

Durban.—The new scheme for endowing Durban with an electric traction installation is expected to be put in hand in June, when the Town Council will have obtained their enabling Act. In the meanwhile, says the *British and South African Export Gazette*, two borough officials are at present visiting this country and America, studying existing electric tram installations, and their report will serve for the guidance of the town authorities. It is intended to take in hand first, the important section from the Point to the end of Musgrave Road, the completion of which is expected to be realised within two years from the beginning of the works. The working of the completed installation is expected to realise economies sufficient to justify the reduction of the electric lighting charge.

Florence.—The large central power station in Florence, to supply electrical energy for the tramways in that city, has just been completed. The plant comprises two 700-H.P. and one 390-H.P. compound condensing engines constructed by Messrs. Escher Wyss and Co., of Zurich, and three continuous current Thomson-Houston dynamos of equal capacity.

Gas Traction Replaced by Electric Traction.—Gas motors for street railways have evidently not been a practical success in Germany. Some time ago, according to the *Elektrotechnische Zeitschrift*, gas traction was given up on the Hirschberg Valley line, with the view of introducing electric traction. And now it is announced that the company owning the Dessau street railway, which has been hitherto worked by gas motors, have decided to employ electric traction.

Gateshead.—At the meeting of the Gateshead and District Tramway Company last week, it was reported that the new arrangement with the British Electric Traction Company, who take over the lease, was progressing satisfactorily. The Bill for granting the necessary powers was now before Parliament unopposed.

Hastings.—Mr. W. M. Murphy, of the Hastings, Bexhill and District Light Railway Electric Company, has assented to the terms and conditions embodied in the recommendations made in respect of the company's proposed trams.

Huddersfield.—The General Purposes Committee, consisting of the whole of the members of the Town Council, has adopted a report of Mr. Campbell, the borough engineer and surveyor, recommending the use of electric traction on the whole of the tramways of the borough. It was resolved that the work should be carried out in sections, and steps be taken to obtain borrowing powers for the necessary additional capital, estimated roundly at £100,000. The first report on the subject, made by the tramways manager, Mr. J. Pogson, suggested that before the Tramways Committee finally determined upon the adoption of electric traction the Lindley, Edgerton, and Outlane routes should be worked by electricity as an experiment. Mr. Pogson recommended that there should be a separate power house apart from the present electric lighting station, but it was decided to consult the Electric Lighting Committee as to the terms on which they could supply power. Mr. A. B. Mountain, the electrical engineer, thereupon prepared a report in which he expressed a preference for the Fartown route being experimented upon, as it was nearer to the generating works. The energy, he pointed out, could be provided at those works by alterations and additions to the

existing machinery. Mr. Pogson rejoined with a second report, in which he differed on several points from the electrical engineer, but especially in regard to the fact that there would be dual control at the electric lighting station if that station were also used for the production of motive power; while, moreover, if the Lindley route only were converted the cost would be several hundred pounds a year more in capital charges, and over £1,000 more if the whole of the routes in the borough were converted. A further disadvantage would be that the maximum amount of power would be required for lighting and motive purposes at one and the same time, and that the Tramways Committee would not have proper control over the works. Confronted with these divergences of opinion, says the *Bradford Observer*, the committee called in Mr. Campbell, who, as already stated, has prepared a report, in which he contends in the main that the wisest policy would be to adopt electricity as a motor generally. He sees no reason whatever why such a tramway service of first rank should not be established on a sound basis, notwithstanding the capital required in addition to the capital already invested. Regarding the electrical engineer's proposal to generate power at the existing works, Mr. Campbell remarks that only in extreme cases is it advisable to combine traction with lighting and other power. Where the system is small it is sometimes adopted, but traction was bound to suffer unless one manager had complete control over both branches, that is, light and traction. If it were intended to convey the idea that the lighting department could make or supply power cheaper than the tramways department, there were no facts to support it. The committee should not, Mr. Campbell thinks, be guided by what is merely required for the section of tramways under consideration, but rather face the whole question. Assuming that the equipment of the whole of the local tramways electrically must at no distant date become an accomplished fact, he had viewed various sites, and come to the conclusion that the Corporation's property at the Longroyd Bridge destructor works would make an ideal site for a power station. The cost of providing a separate power station for the Lindley section only, and the necessary feeders and cars, he estimates at £30,127. The estimate of the electrical engineer for the same equipment, but by extending the present electric lighting works, is £37,500. For converting the whole of the system to electric traction, with a separate power house, Mr. Campbell calculates that £99,605 of new capital would be required, bringing the total capital expenditure on the tramways up to £239,310. He estimates that by running 45 cars for 310 days in the year (there being no Sunday service), the income would be £62,775, and that after meeting all claims, there would be a profit of £22,344. At present the total income from the system is £30,870, and the profit for the year ended March, 1898, was £826.

Italy.— Some experiments with a new system of electric tramway traction, devised by Signor Riccardo Arno and Signor Aristide Caramagna, have just been carried out at Turin.

London.—A London paper says that a proposal is on foot to connect by an electric tramway system several of London's S.W. suburbs with the Thames at Westminster, Waterloo, and London Bridges, and Hampton Court. The scheme has been submitted to several local authorities.

Manchester.—The Tramways Committee last week decided to invite tenders for the supply of three types of tramcars to be thoroughly tested shortly.

Manchester and Middleton.—The Light Railway Commissioners on Tuesday held an inquiry at Manchester with reference to the application of the British Electric Traction Company for an extension order authorising them to construct a light railway between Cheetham Hill and Rhodes, near Middleton. The application was strenuously opposed by the Manchester Corporation, into whose hands Mr. Balfour Browne said every one of the existing tramways would fall in two years, and they had obtained powers to work them electrically. After a short time the Earl of Jersey said it was not necessary to continue the inquiry, as although a local authority had not an absolute veto under the Light Railways Act, yet the Commissioners were bound to pay the very greatest attention to what it said. No one could suppose that a great town like Manchester would willingly consent to an outside authority having trams running in its jurisdiction.

Mumbles.—The British Electric Traction Company have arranged terms with the Swansea and Mumbles Railway Company for the taking over of the latter company's line, which will be electrically equipped.

Newcastle.—The Newcastle and District Electric Lighting Company is petitioning against the Newcastle Corporation Bill for generating electric energy for the operation of its tramways.

Glasgow.—Mr. H. F. Parshall was recently consulted by the sub-committee of the Tramway Committee upon the system of generating and distributing energy for the overhead tramway system. We have not room to give his report *in extenso* this week, but the general conclusions are summarised as follows:—"Having regard to the nature of your tramway system as a whole, a single generating station, with high tension multiphase transmission to sub-stations located in some of your existing car sheds and stables, will be found the most economical to work, involves less capital outlay, takes less time to instal, lends itself to complying with the Board of Trade requirements and the safety of your property in gas and water mains, and is of a type least likely to be superseded when further demands are made, either as an increase in the area to be served, or increase of traffic over the existing system. In following my recommendations you will be setting out with an installation of the highest class, and will be unhampered by trying to make use of plant or arrangements that are either obsolete or unsuited for the economical working of your system of electric tramways." The Tramway Sub-committee report that they have been considering the question of Mr. Parshall's report, and have conferred with the Electricity Sub-committee. They consider Mr. Parshall's recommendations as stated in the above to be sound from the economic as well as from the engineering point of view, and they are quite convinced that the power will be produced cheaper by having one generating station for the tramways at, say, 6,500 volts, with district sub-stations in the present tramway depôts, as suggested, each of which would form a distributing centre, than by having separate installations of plant at several power stations generating current at 500 volts. They think also that, for the tramway system of the near future, which will extend, at numerous points, and to a considerable distance beyond the city limits, a high tension station with sub-stations will be most efficient, and will best fulfil the requirements of the Board of Trade, and avoid electrolysis of the water and gas pipes. They have also before them the important fact that the maximum loads for lighting and traction occur at the same time. It also seems obvious that the undertaking which each of the departments in question has before it at present is sufficiently large of itself to admit of the adoption of the most economical generating units and the production of current at the lowest possible cost. That the Electricity Committee could supply current for the tramways need not, they say, be questioned, but they do not claim that they will be able to supply it either better or cheaper than the Tramways Committee could produce it for themselves. They could only produce it as cheaply as the Tramways Committee by putting down special traction machinery for the purpose, and in that case, in order to arrive at the exact cost, the power for traction would require to be produced and accounted for as a separate undertaking, just as if the Tramways Committee were producing it for themselves. It is clear that the supplying of power for the tramways by the Electricity Committee could be of no possible benefit to them unless they were to do so at a profit, which is quite inadmissible. After the fullest consideration of the whole circumstances of the case, their conclusion is that to have the power stations for lighting and traction combined would be of no benefit to either committee, but that, on the other hand, any such arrangement would be a great disadvantage to the Tramways Department. As pointed out in Mr. Parshall's report, with a continuous traction load for over 20 hours out of the 24, as against only a few hours' continuous lighting load, the Tramways Committee can take about four times the work out of their plant that can be taken out of the same amount of plant for lighting. In addition to what has already been suggested, this gives the Tramways Committee another distinct economic advantage in putting down their own plant and producing and distributing their own current on the lines indicated. A still greater advantage is clearly obvious in the matter of administration. The responsibility for the operating of the tramway system should undoubtedly carry with it the control of the power, which is the mainspring of the whole concern. Whoever controls the power controls the tramways. The Tramways Department, being a commercial undertaking, has always been self-contained, and, in their opinion, should remain so. The Tramways Committee have supplied the horse-power. They have also supplied the electric power for the sectional demonstration. Now they are in a position to begin generating their electric current for the whole system on the best known principle, and with the most up-to-date machinery for this special purpose. Keeping in view the magnitude of the operations confronting both committees, they can see no benefit whatever to be gained, but quite the reverse, by any combined arrangement, which would mean two separate committees being engaged in carrying out the powers of the Tramway Acts, one committee supplying the power and another working the tramways. Any such dual control should, in their opinion, be avoided. They have, therefore, pleasure in recommending that the Tramways Committee, who are responsible to the Corporation for the efficient working of the Corporation Tramways, be still entrusted with the supplying and distributing of their own power for electric traction, and that it be remitted to that committee to proceed to convert the tramways and arrange for the supply and distribution of power on the general lines indicated by Mr. Parshall.

Instead of the police being allowed to turn off the tramway current in the event of mishaps with other wires, it has been decided by the Corporation that their sole power shall lie in the diversion of the traffic so that no one may stand any chance of receiving injury from fallen wires, &c.

Porth and Pontypridd.—Last week Mr. D. F. Sugrue, of the British Electric Traction Company, went from Swansea to take formal possession of the four miles of tramway lying between Pontypridd and Porth, which the company has acquired from Mr. Solomon Andrews. It is intended to equip it electrically.

Reading.—Further correspondence has been passing between the Council and the Tramways Company on the question of purchase. The Tramways Committee has recommended that all Corporation tramways, whether acquired or newly-constructed, shall be worked on the overhead wire system, double lines being laid where possible; also that an electrical engineer be appointed to advise on the matter. The Council last week adopted this report.

Rome.—The adoption of electric traction on eight further tramway routes in Rome has just been officially authorised.

Sedgley.—It was reported to the District Council last week that the negotiations with the British Electric Traction Company had been concluded. The company had agreed to purchase the Council's right of pre-emption and had undertaken to lay down and equip with electrical energy the existing tramway within the next two years.

Sheffield.—A local paper says that May is the time now fixed for opening the electric tram system.

Southampton.—Members of the Tramway Committee visited Liverpool and Glasgow last week to inspect the electric tramways.

Stockton.—The Rural District Council has received a letter from the Durham County Council regarding the proposal of the Imperial Tramways Company to apply to the Light Railway Commissioners for power to lay a system of electric tramways in the borough of Darlington, and probably outside of the borough to Haughton-le-Skerne, and also to supply the necessary electric power, by laying a cable from their power station at Stockton by way of Hartburn, Elton, Long Newton, Sadberge, Haughton-le-Skerne to Darlington. The company desired to know whether in view of this proposal any objection would be offered by the authorities interested, providing the cable was laid and all details carried out to their satisfaction. The company has approached the Stockton Council asking whether they would take a supply of current for public lighting. The clerk replied asking for details as to cost, and this matter is under consideration, though nothing can be done before October. The question whether the Tramway Company should be allowed to lay their cable through Stockton for the purpose of working the Darlington tramways has been referred to a committee with power to employ an expert.

Swansea.—The construction of the British Electric Traction Company's station at St. Helen's was commenced last week. Messrs. Walters & John having secured the contract for the structure at about £10,000.

Wednesbury.—The Town Council has adopted a recommendation from the General Purposes Committee recognising the expediency, if the tramway lines within the borough with their steam and electrical equipment, except the cars and depôts, could be acquired by agreement with the South Staffordshire Tramway Company on reasonable terms, of the Council purchasing them and agreeing to grant a lease of the lines to an approved company to work them for a term not exceeding 21 years, also that a sub-committee be appointed to conduct negotiations, and enter into a provisional agreement with the company for purchasing and leasing the lines, and also to confer and advise with the town clerk as to the opposition to the company's Bill in Parliament, if it should be necessary for the same to be proceeded with. A sub-committee was appointed to conduct the negotiations.

West Glamorgan.—It is understood that the scheme for constructing a light railway to Reynoldston and through the Peninsula of Gower has been abandoned, and that the syndicate which have the matter in hand, have substituted a proposal to construct a line connecting the Swansea and Mumbles Railway with Rhossily Bay, and skirting all the beautiful bays of the Gower-coast *en route*. Surveyors are now engaged on the proposed line of country to be utilised.

Wrexham.—The Council has just been going into the question of clauses in the Wrexham District Tramways provisional order, and they have suggested several alterations to the company.

TELEGRAPH AND TELEPHONE NOTES.

German Telegraphs to the East—We learn that the English Ambassador in Constantinople is lending his support to the protest made by the Eastern Telegraph Company against the concessions given to the German director of the Anatolian Railway for the laying of a cable between Constanza and Constantinople. Although it is only right that Her Majesty's Government should lend countenance to an English company in such a matter, still, the affair is so essentially a commercial one, and the benefits to be derived by England from the establishment of a competing line to India and the East are so obvious, that it would be well if, while lending support to the Eastern Telegraph Company, H.M. Government were to obtain from this company some assurance that in return for the assistance so given the company should pay more consideration to the demands of India for a reduction of telegraph rates between England and India. During the last International Telegraph Conference, held at Buda-Pesth, the representatives of the Indian Government, besides many other delegates, impressed upon the Eastern Telegraph Company the strong desire that was felt for a reduction of the existing high rates charged for telegrams to India, but the company declined to make any change. Under these conditions, it is perhaps not altogether to be regretted that the possibility of active competition has arisen, and is being fostered by the German Government. The difficulties in the way of the proposed new scheme are not great, and the need for such a line, apart from competition in rates, may perhaps be better appreciated when we remember that since about the end of January last the Indo-European landlines have been interrupted on several occasions. In establishing the new line to the East, it would be advantageous, we think, to continue the submarine cable from Constantinople, following the north shore of Anatolia, to Trebizond, touching on the way, perhaps, at Koslu Bay, Sinope, and Kerasundz—a cable not much more than 550 miles in length. From Trebizond to Kuweit, a port on the north shore of the Persian Gulf, under the sovereignty of the Sultan of Turkey, and which it is rumoured the Germans are about to lease, only requires about 800 miles of landline if the route *viâ* Diarbekir, Bagdad, and the Euphrates valley is followed; and at the head of the Persian Gulf the line could easily be connected with the Indo-European Government system, which would thus be in a position to arrange for the reduced rates which they asked for at Buda-Pesth. The Euphrates valley landline has hitherto been looked on as a negligible quantity, as under Turkish management it has been practically useless; but now that the matter is being taken up by Germany we may look for a service at least as efficient as that afforded by the Indo-European Company's landlines, which were to a great extent initiated by German enterprise. As showing the diversity of the interests held by the Eastern Telegraph Company, it is noticeable that in the case above referred to they claim the support of Her Majesty's Government; whereas, they are, or were, large shareholders in the case of the Deutsche See-Telegraphen Gesellschaft, a Cologne company, based on a German concession, which has for ultimate object the establishment of a line of cable from Germany across the Atlantic, which shall not touch on English ground, and shall afford a means of competition against the existing Atlantic cables which are to a great extent owned by English capitalists.

The Government and the Telephones.—Sir James Fergusson writes to the *Times* with reference to Monday's debate in the House, pointing out that the Secretary to the Treasury, in his speech, contended that he could replace the whole of the National Telephone Company's wires for £2,500,000. He argued that as the cost of 96,000 public wires was stated to the Committee to have been on the average £40 a wire, making £3,800,000, if £1,250,000 of "watered capital" (*i.e.*, the surplus paid for the market price of the shares of the companies absorbed) be deducted, it leaves a little over £2,500,000. "Whatever be the merits of the 'water' question, it cannot be right," says Sir James, "to deduct the sum so described from the actual cost of the wires, by this time increased to over 100,000. The blunder is remarkable as having been made by a Finance Minister. I should like to add that since the agreement was made with the Post Office in 1892, whereby the trunk wires were acquired by Government, and certain restrictions upon the action of the company removed, the additional capital expended has been almost £2,500,000, in which there was no 'water' at all, and the lines (including private lines) have increased from 48,000 to 120,000."

The Hawaiian Cable.—A Washington despatch dated 3rd inst. says that the item dealing with the laying of a cable to Hawaii has been struck out of the Sundry Civil Appropriations Bill on the insistence of the members of the House of Representatives on the Conference Committee.

The National Telephone Company's Bills.—The Standing Orders Committee on Tuesday had before it the National Telephone Company (Nos. 1 and 2) Bills, against which the Examiners of Private Bills have reported that the rules of Parliament have not been complied with. The Bills, which are to some extent alternative proposals, have mainly in view the acquisition of powers for opening up streets, &c., for the laying down of their wires in urban districts, and they also constitute the Railway and Canal Commissioners a court of appeal in cases of dispute.—The committee decided to dispense with the Standing Orders, and allow the Bills to proceed on condition that the clause in each Bill referring disputes with regard to road opening to the Railway Commission, be struck out.

The Pacific Cable.—In an article on "Colonial Affairs" the *Morning Post* says:—"Telegraphic communication between the Pacific Colonies is becoming every day more a matter of necessity, and as it is understood that all the parties concerned are prepared to pay their share of the cost of the upkeep it is difficult to see why there should be any further delay in the matter. Of course it is to be an all-British cable—that is to say, it is not to touch any station that is not on British territory, but there is no reason why there should not be collateral connections, which could be cut at any moment in the event of a European war. The question of Samoa being a group of neutral islands does not matter, as Samoa would be only a collateral connection, but if order is to be restored in Samoa cable communication between Apia and Vancouver must be brought about, and brought about as soon as possible."

Post Office Telephone Operators.—In the House of Commons the other day, replying to Mr. Provand, Mr. Hanbury said:—"With few exceptions, the operators on the Post Office local telephone exchanges are women. They, as well as the operators on the trunk lines, are at present unestablished, and have no fixed scales of pay, but proposals are now before the Treasury for settling their position and wages. In the meanwhile they are paid wages of varying amounts, according to their length of service, and are allowed holidays, sick pay, and medical attendance, but, being at present unestablished, they are not entitled to pensions. All operators taken over from the National Telephone Company have been granted an increase of 4s. per week."

Subsidised and State-Owned Cables.—At a meeting of the British Empire League held last Monday, under the presidency of the Duke of Devonshire, the following resolutions were moved by the Hon. W. P. Reeves, the Agent-General for New Zealand:—1. "That this Council noted with pleasure the action of the Australian Colonies and New Zealand in offering to guarantee an increased proportion of the cost of an all-British cable, and expresses satisfaction that the Dominion of Canada is willing to share the remaining proportion equally with the mother-country." 2. "That in view of the undoubted value of the Pacific cable to the Empire, and of its probably profitable result as a commercial enterprise, the Council expresses a hope that every effort will be made to overcome any obstacles that may delay the co-operation of the mother-country in the undertaking." After an interesting discussion, the further consideration of the resolutions was adjourned till next meeting. We do not propose here to deal at any length with the subject above referred to, as we have already on many occasions expressed our views, which we have found no reason to alter. We would, however, point out that the position

would be much simplified by the publication of the evidence and reports connected with the Pacific Cable Commission held at the Colonial Office at the end of 1896. With this information before them, we venture to say that those who are not connected with the official world would be in a better position, not only to discuss the subject, but possibly also to understand the sources of difficulties and objections which have delayed its accomplishment, and to assess accurately the true value of these. Some space is devoted in a contemporary to furnishing objections to the proposal that the system of cables advocated by Sir Sandford Fleming should be State-owned. This objection, however, in the present instance can only be a matter of degree, not of principle, as the lines with which these State-owned cables would to some extent compete are at present in receipt of aid from various Government sources, and have already received in subsidies, guarantees, &c., considerably more than £3,000,000, apart from various concessions and privileges which stand in the way of free competition. In reviewing an article which appeared in last month's *Nineteenth Century*, our contemporary says: "Mr. Hurd states that 'the present tax on intercommunication would cease;' but it does not appear that messages are to be carried free." To us it seems clear that Mr. Hurd in no way suggests the total abolition of payment for telegrams, the "tax" he refers to appears to be the excessive amount charged for telegrams beyond the sum which would afford a fair return on a fair estimate of the cost of the cables at present carrying the traffic. As to the question of cables in war time, dealt with by Sir James Anderson several years ago, we find that Sir James Anderson writes: "I do assert very positively that a dozen *Alabama*-like craft can be very quickly made ready to cut as many cables as may be desired." It is clear that the cables to suffer first would be those most easily reached and destroyed; at present these undoubtedly are the group of cables which cross the mouth of the English Channel, off Brest. Here converge *all* the submarine cables which form our means of communication with Gibraltar, Malta, Egypt, Africa, India, China, Australia, and New Zealand, and these run for over 150 miles in water under 100 fathoms in depth; and in this area the "*Alabama*-like craft," spoken of by Sir James Anderson, could in a very short time work such havoc, as would probably convince even those most interested in the existing cables, of the national value of a system of cables such as that proposed by Sir Sandford Fleming, which would lie in deep water, and far from immediate danger of interruption. We are quite aware that in theory the mouth of the Channel will be so thoroughly patrolled, that the disaster we foreshadow is theoretically impossible, but in any case, to use a homely metaphor, we would much prefer that "all the eggs should not be in one basket." Our contemporary advances as an argument to be carefully weighed, that should the State take action in extending the strategical cables referred to, one of the effects would be to destroy "the international character which submarine cables have hitherto borne." It is extremely doubtful to us whether in war time cables have ever borne an international character. Even in the recent war we have seen cables, the property of English companies, cut and interrupted by the belligerents, and, on the other hand, we have also seen telegraph companies owning such cables, refuse to restore and work them pending hostilities.

Telegraph Act (1892) Amendment Bill.—In the House of Commons the other day, on the order that the Telegraph Act (1892) Amendment Bill be read a first time, Sir C. Cameron asked, as a point of order, whether this Bill did not deal with matters which should be dealt with in a public and not a private Bill. The Bill now before the House dealt not merely with the whole metropolitan area but with the entire United Kingdom, and there was no possibility of remedying the matter by expunging clauses, as practically the entire Bill would have to be expunged. The Bill established a new jurisdiction which was to supersede the local authority in matters affecting their streets. The Act which the Bill proposed to amend was one conferring powers not on the National Telephone Company, but upon the Postmaster-General; the Telephone Company only came forward as the licensee of the Postmaster-General. The Speaker replied at some length to Sir C. Cameron, and he said that he regarded the discussion on the first reading of a private Bill as being now as completely obsolete as on the first reading of public Bills. If the hon. member desired to bring forward his objections to the Bill on its merits, his opportunity would arise on the second reading. The Bill was then read a first time.

Telegraphic Interruptions and Repairs:—

Cables.	Down.		Repaired.
Amazon Company's cable—			
Cable beyond Gurupa ...	June 11th, 1898	...	...
French Company's cables—			
New York-Hayti ...	Feb. 10th, 1899	...	...
Paramaribo-Cayenne ...	Feb. 10th, 1899	...	...
Dakar-Bathurst	Feb. 9th, 1899	...	...
Landlines.			
Lines near Fao (between Bagdad and Bassora) ...	Feb. 16th, 1899	...	March, 5th 1899.
Communication with Interior of Nicaragua, except Rivas	Feb. 24th, 1899	...	...
Indo-European lines (between Kertsch and Soukhoum-Kale)	March 1st, 1899	...	March 4th, 1899
Odessa and Kertsch ...	March 6th, 1899	...	...
Saigon-Bangkok	March 7th, 1899	...	...

A Telephone Service Meter.—We understand that the Barnet automatic telephone service meter is being pushed in this country by a syndicate. The meter is the invention of Mr. T. Barnet, of Sydney. When municipalisation of telephone systems is in prospect, with a view to more extensive and efficient use of this means of communication, the syndicate comes forward at the psychological moment to press upon telephone undertakers the advantages of a toll system in preference to the usual fixed charge per annum, the cost of a service being regulated by the extent to which a subscriber uses it. If a price were to be paid for each call, it would put a brake upon those who occupy the lines with what have been termed "frivolous" and unnecessary messages, while it would bring the telephone within the reach of the large class who are indisposed to pay a high yearly subscription. A small nominal subscription to every user with a trifling charge for each call is in harmony with some of evidence given before the Select Parliamentary Committee and more or less with the findings stated in the report of that Committee. We are not yet able to state the exact details of the Barnet service meter, but the Barnet Automatic Telephone Service Meter Syndicate is represented in this country and the Continent by Mr. A. L. Baird (of Sydney), at 55, Chancery Lane, E.C.

CONTRACTS OPEN AND CLOSED.

OPEN.

Aberdeen.—March 10th. The Electric Lighting Committee wants tenders for the supply of copper strip. See "Official Notices" March 3rd.

Aberdeen.—March 29th. The Corporation wants tenders for permanent way, overhead line work, feeder and test cables, cars, switchboard, &c., for electric tramways. See our "Official Notices" this week.

Ambleside.—Tenders are, according to an exchange, about to be invited for gas engines, generators, boosters, switchboard and battery, and mains for electric lighting at Ambleside. Intending tenderers should send their names to the engineers, Messrs. Hopkinsons & Talbot, 26, Victoria Street, S.W.

Barking Town.—March 27th. The Urban Council wants tenders for an 80-kw. steam dynamo (vertical high speed enclosed engine and two-pole dynamo), with pipe-work and accessories. See our "Official Notices" this week.

Belfast.—March 16th. The Electric Committee wants tenders for switchboard extensions. See our "Official Notices" February 24th.

Bury.—March 20th. The Electric Lighting Committee wants tenders for a Lancashire boiler with steam and other pipes. See "Official Notices" March 3rd.

Canterbury.—March 14th. Tenders are wanted for boiler house plant, engine house plant, extensions of switchboard and mains. See our "Official Notices" February 17th.

Dundee.—March 15th. The Gas Commissioners are inviting tenders for four Lancashire boilers, two 450-H.P. steam engines and dynamos, and one 700-H.P. steam engine and dynamo. Particulars from the electrical engineer, Mr. W. H. Tittensor. See our "Official Notices" February 17th.

France.—February 16th. Tenders are being invited by the French Post and Telegraph Authorities in Paris for the supply of 825 tons of bronze or copper wire. Tenders to be sent to Le Sous-Secretariat d'Etat des Postes et des Telegraphes, Rue de Grenelle, 103, Paris, whence particulars may be obtained.

Glasgow.—March 15th. The Corporation wants tenders for the reconstruction of tramways according to specification. See our "Official Notices" March 3rd.

Greenock.—March 16th. The Police Board wants tenders for mains, arc lamps, poles, &c. See "Official Notices" March 3rd.

Hammersmith.—March 15th. The Vestry invites tenders for water-tube boilers, 1,000-H.P. slow speed engines, and two 60-kw. alternators, feeders, and cast-iron pipes. See "Official Notices" February 24th.

Lewes.—March 24th. The Corporation is prepared to receive offers from those willing to establish an electricity supply undertaking. See our "Official Notices" February 17th.

London.—March 14th. The Great Central Railway Company are prepared to receive tenders for the supply, during the 12 months ending April 30th, 1900, of electric light materials. Sealed tenders endorsed "Tender for——" to be in the hands of Mr. Oliver S. Holt, secretary, not later than 10 a.m. on Tuesday, March 14th.

Pernambuco.—March 18th. The Government of the State of Pernambuco invites tenders for the construction of an electric tramway to run between that city and Olinda, situated at about three miles distance. Tenders, duly sealed, must be addressed to the "Secretaria da Industria," Pernambuco, and should be received there not later than March 18th. Further particulars may be obtained on application at the Commercial Department of the Foreign Office any day between the hours of 11 a.m. and 6 p.m.

(*Continued on page* 383.)

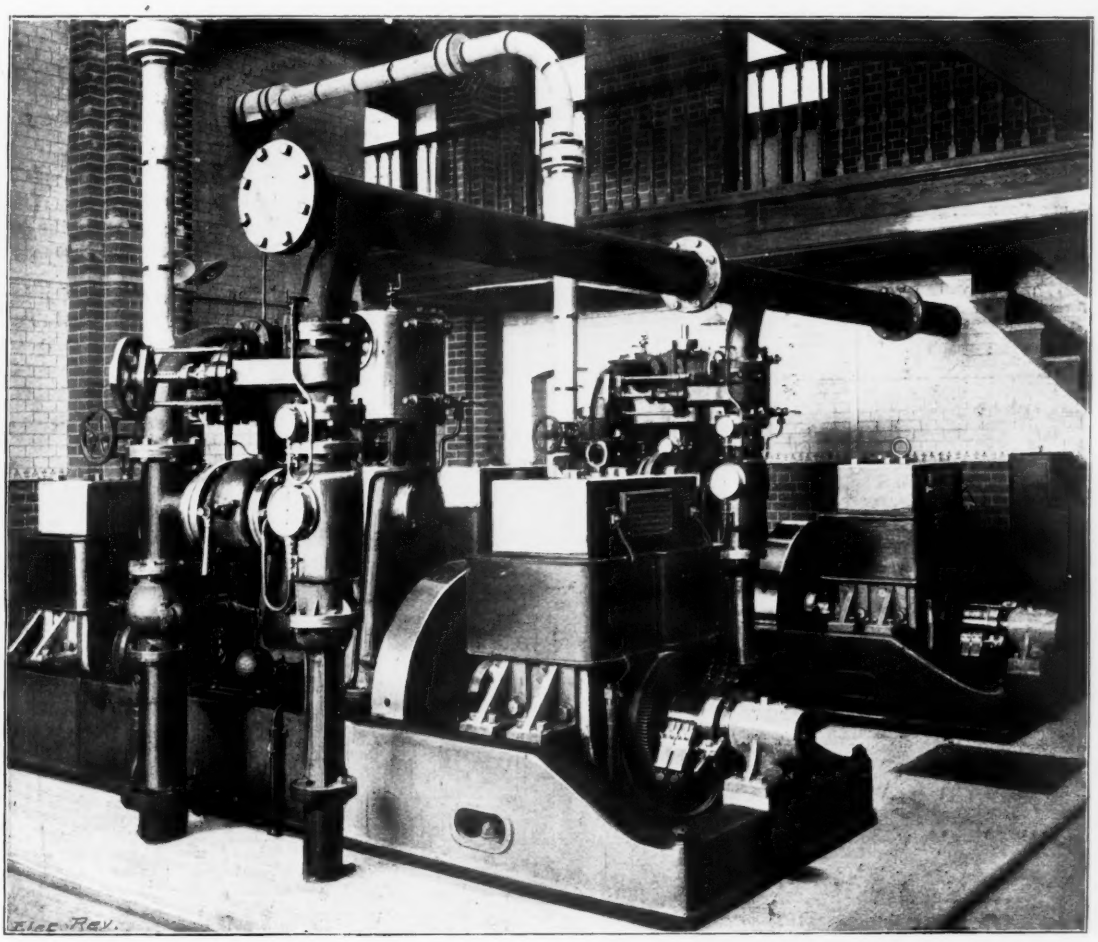
CANTERBURY CORPORATION ELECTRICITY WORKS.

Various forms of light have been in use in the ancient city of Canterbury since the days of Chaucer's Pilgrims, and we have the pleasure of chronicling the fact that the electric light has now been adopted. It has taken a long time to come about. The supply of gas and water in Canterbury is in the hands of one company, which, ten years ago, promoted a Bill for the further extension of their plant and powers, including authority to supply electrical energy. The City Fathers, however, thought that the company was going a bit too far, with the result that the electric lighting powers sought by the gas and water company were refused. Hardly, however, had the Corporation disposed of this application than the Brush Company gave them notice of their intention to apply for a provisional order, with the usual result that the Town Council got their own order, it receiving the Royal assent on June 11th, 1891. The Brush Company, not to be left out in the cold, immediately began negotiations with the Corporation for a transfer of their powers, and finally an agreement was arrived at, but for some reason, which we have not been able to discover, the agreement was never signed.

The next step was made by an enterprising citizen, by name Councillor Lukey, who, in remodelling the ancient County Hotel, lighted it throughout with the electric light, generating the current upon the premises. So satisfactory did the sample appear, that the Council took into consideration the advisability of giving the whole of the citizens the opportunity of lighting their premises electrically, and finally, in September, 1895, the Council appointed Mr. Robert Hammond, M.Inst.C.E., M.I.E.E., to draw up a report. An Electric Lighting Committee was formed, and Alderman Mason, who from the first has been the enthusiastic friend of the new illuminant, was appointed the chairman.

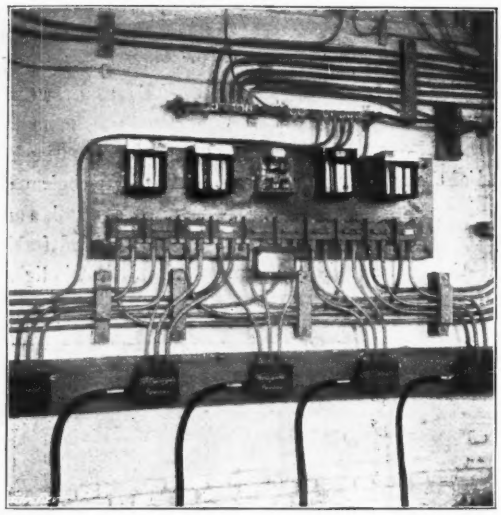
In due course the report made its appearance, and, as may be expected, Mr. Hammond strongly urged the advisability of the Corporation taking up the work of electric lighting themselves, and prognosticated a profitable future for the undertaking in view of the number of low-roofed shops and premises abounding in the old city. In addition Mr. Hammond urged that a refuse destructor should be erected. In this connection we cull a sentence from his report:—

" . . . . I think there will be an opportunity of utilising in Canterbury what is, at the present time, a waste, and, I might venture to add, a dangerous product. I refer to the city refuse, which has hitherto been dealt with in a laborious and costly way. It is, as you know, at present carted to the Sewage Disposal Works. On the way it turns one of the fairest lanes in England, much frequented by citizens and neighbours, into a polluted place. At its



View of Engine and Dynamo Room.

destination it has been heaped into a mound forming an eyesore to the passing railway travellers. The natural and proper method of disposal of the refuse of dustbins is by



Cable Connections to Meterboard and Switchboard.

cremation, and if the Corporation adopt this method it would be an economical plan to combine the dust destructor works with those for electric lighting."

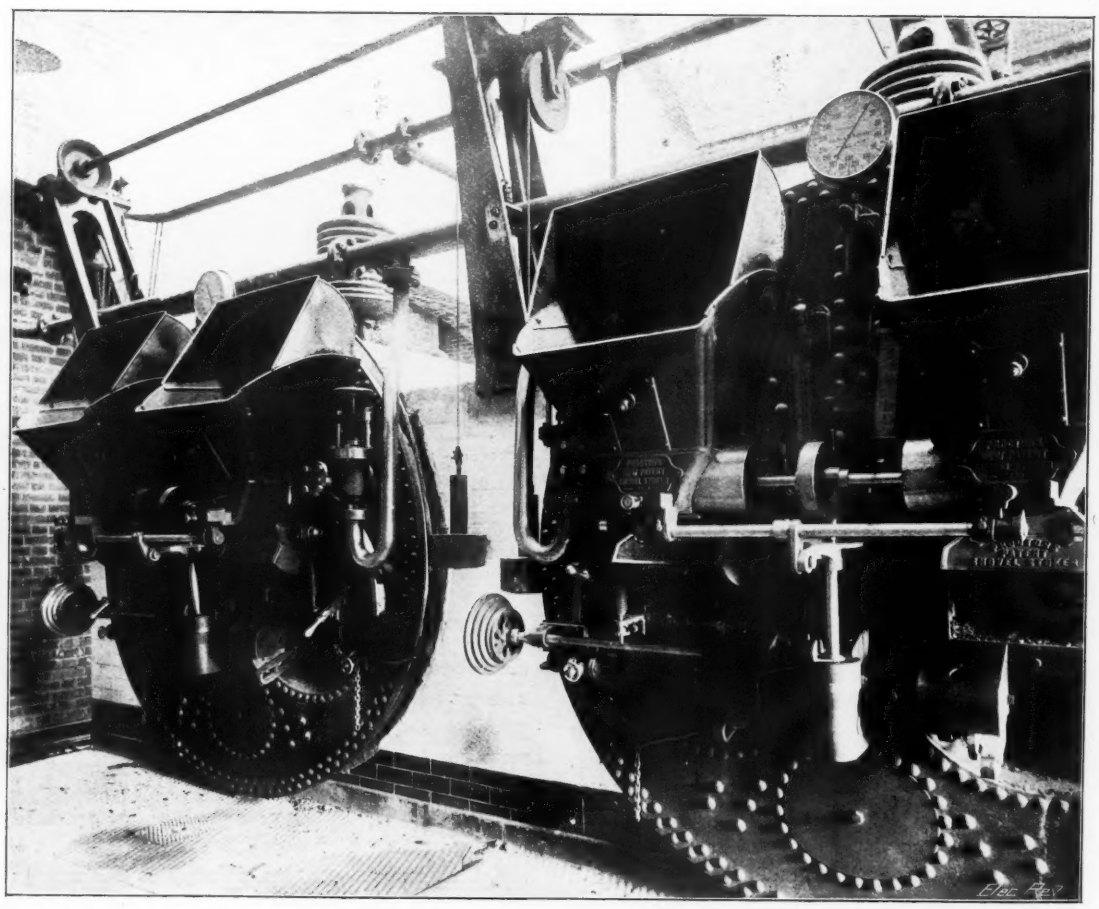
Board was made for sanction to a loan of £20,000 to carry out the first works.

The opponents of the scheme, however, though temporarily thwarted, organised a very strong opposition to it, with the result that on one pretext or another, it was delayed for a whole year, and the Local Government Board inquiry did not occur until May, 1897. It proved a most exciting one, the solicitors of the gas company having promoted a memorial against the electric lighting, and the opposition being conducted by Queen's counsel and by leading solicitors in the town. However, all was of no avail, and finally the Local Government Board granted the loan. Mr. Hammond was allowed to get to work, and in due course to issue his specification. This saw the light in November, 1897; tenders were duly received, and the contracts distributed as follows:—

Buildings and foundations ...	A. J. Brewster, Canterbury.
Boiler house plant	Robert Taylor & Son.
Engine house plant	India-Rubber, Gutta-Percha, and Telegraph Works Co., Limited.
Overhead travelling crane ...	James Spencer & Co.
Switchboard and instruments ...	Crompton & Co., Limited.
Battery of accumulators	Chloride Electrical Storage Syndicate, Limited.
Mains—insulated cables and trenching	Western Electric Company.
Public lamps—arc and incandescent lamps, posts, and brackets	Crompton & Co.
Meters	S. Z. de Ferranti, Limited.

The system fixed upon by Mr. Hammond was the low tension three-wire system with a voltage between the outers of 440 volts, feeders being taken from the works to suitable spots in the city.

In the course of laying the mains the Corporation issued a circular to consumers expressing their willingness to carry



Boilers and Mechanical Stokers.

After a good deal of discussion Mr. Hammond's report was adopted, and an application to the Local Government

the supply mains into consumers' premises free provided that the request for connection was made while the trench in

front of the premises was opened. The offer was very freely accepted, and during the laying of the mains 136 premises were connected up, thus putting the works in the magnificent position of starting with over 3,000 lamps on the first night of supply. Indeed, the capacity of one of the sets of plant is fully taxed to supply the pioneer customers, with the result that the Corporation have instructed Mr. Hammond to draw a specification for an extension involving a further expenditure of £12,000, and tenders for the additional plant were recently invited.

A portion of the new work consists in laying mains in the Cathedral precincts, and we hope it will not be long before the venerable cathedral will have introduced into it the only light which should be permitted in these ancient edifices, it being well known that gas has a most deleterious effect upon the stonework, as evidenced by the stone dust which is to be found in all gas lighted churches.

The choice of a site occupied, as it always does, a good deal of anxious thought, but finally one was hit upon, which, though somewhat removed from the heart of the city, has the great countervailing advantage of an ample supply of water for condensing and an easy approach for coals. The buildings were set out by the consulting engineer, the detail plans being ably made by Mr. Adam Horsburgh Campbell, Assoc.M.Inst.C.E., the city surveyor. The contract was let to a local firm, Mr. A. J. Brewster, the chimney, which especially attracts attention, having been erected by Mr. George Tourney.

Description of Plant.

In the boiler house there are two Lancashire boilers, each 30 feet long × 7 feet diameter, designed for a working pressure of 140 lbs. per square inch.

The bulk of the boiler mountings are by Messrs. Charles Winn & Co., and comprise dead weight safety valve, high steam and low water valve, junction valves, &c., but the water gauges and blow-off valves are of Messrs. Hopkinson's manufacture. The furnaces are fed by mechanical stokers, which were made by Messrs. Proctor, and are driven by an electric motor fixed in the economiser chamber. A Cameron feed pump, Sirius injector, and Green's economiser of 96 pipes complete the equipment, the last named being driven by the same motor as the stokers. The whole of the boiler house plant was supplied by Messrs. Robert Taylor & Sons, of Marsden, Yorkshire.

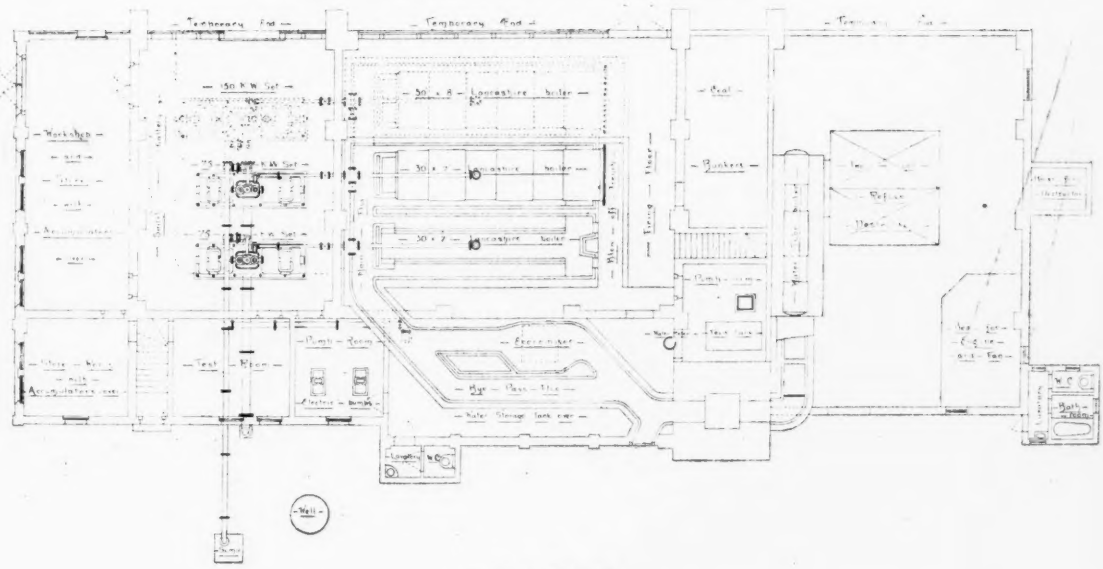
The generating plant at present at work in the engine and dynamo room consists of two Belliss-Silvertown high speed direct current sets, composed of a standard Belliss two-crank compound engine, with two Silvertown single horse-shoe under-type dynamos fixed one at each end of the crankshaft. Each plant is capable of giving an output of 75 kilowatts at a pressure of 220 to 250 volts as an ordinary continuous load, but is designed to work up to 84 kilowatts if required. The working steam pressure will be 125 lbs. per square inch at the engine stop valve when condensing, or 140 lbs. non-condensing. Each set is fitted with a Körting condenser capable of maintaining a vacuum of 26 inches when the engines are working at full load.

Laying Mains.

The condenser is fitted with a non-return valve to prevent water backing up into the cylinder, and there is also a Blake and Knowles automatic valve fixed on the branch pipe leading to the atmosphere. By an ingenious arrangement of levers, an air cock on the condenser is interlocked with the water valve in such fashion that the air cock must be opened, and the vacuum broken in consequence, as soon as the water valve is partly closed. By this means the full head of water on the condenser is ensured.

The steam range is comprised entirely of lapwelded steel pipes. From each boiler there is a 5-inch branch leading into a cast-iron tee piece, which also forms a drain pocket, being fitted with steam traps for leading away any water that may condense in the pipes. These tees are connected

CANTERBURY CORPORATION ELECTRICITY WORKS 1899



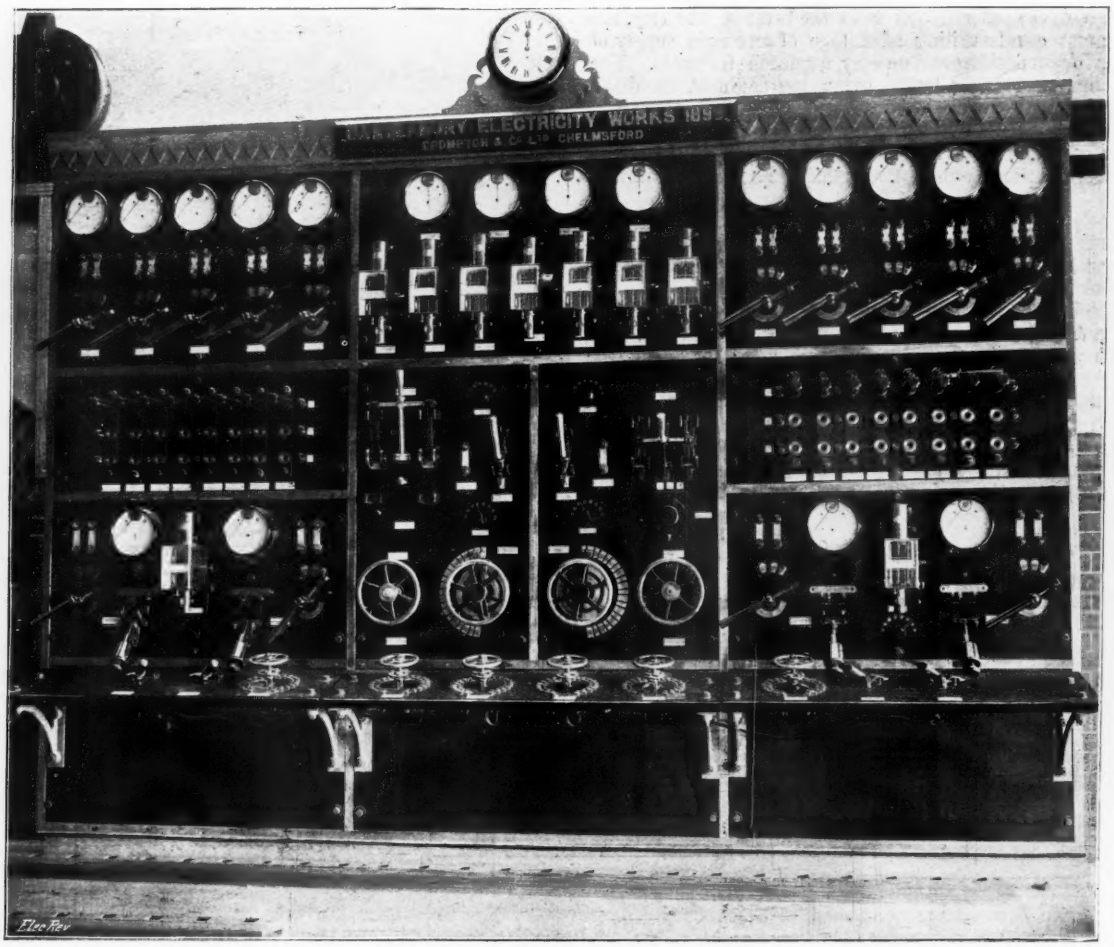
Plan of Station.

by a 6-inch steel pipe fitted with a Hopkinson parallel slide valve, with outside screws, and from them are led the 4-inch steel branches to the engine separators, each branch being furnished with a stop valve which can be manipulated from the engine room floor level.

The steam after leaving the engines is exhausted either direct into the atmosphere or into the condenser already described. The atmospheric exhaust pipe and the discharge pipe from the condenser are laid side by side under the engines, passing through separate tunnels in the concrete foundations, and are continued thence in straight lines to the outside of the buildings. Here the atmospheric pipe takes an upward turn, rising to a height of 10 feet above the roof, and the discharge pipe terminates in a brick sump from whence the condensed steam and water are returned to the river. The high and low pressure drain pipes from the engines follow the same course.

The feed water is drawn from a small underground tank connected to the larger tank by a 3-inch pipe passing through a Kennedy meter. The water level in the feed tank is kept at a constant level by means of a ball valve. There is a separate connection from the town's water main to the feed tank. The exhaust steam from the feed pump is utilised to raise the temperature of the feed water, a flat condensing coil being fixed in the feed-water tank for this purpose. The lower end of this coil is connected to the base of the overflow pipe. The condensed steam finds its way through this pipe to the drains, and any vapour that may remain is carried away up the chimney, the overflow pipe being extended vertically with this object in view, and having a branch formed in the side to serve as the overflow from the tank.

The feed pump has two deliveries, and from it to the boilers there is a complete double range of feed pipe, one for



Switchboard.

The water for boiler feed and for condensing purposes is pumped from a sump outside the building by means of two electrically driven centrifugal pumps, each capable of lifting 5,000 gallons per hour, the total lift being about 30 feet. The pumps are by Messrs. Evans, of Wolverhampton, and are driven by Silvertown motors. Both pumps deliver into a cast-iron water storage tank of a capacity of 20,000 gallons, a float and index being provided for showing in the engine room the height of water in the tank.

The storage tank is supported on girders over the economiser chamber for which it serves as the roof. The town's water supply can also be pressed into the service if required, a 3-inch connection having been made to the storage tank with valve outside the pump chamber.

The water supply to the condensers is carried overhead across the engine room, and with the exception of the steam branches this is the only overhead pipe in this part of the works.

hot feed and the other for cold. These feed pipes are 3-inch cast-iron pipes, and are fitted with Hopkinson valves. The cold feed passes direct from the pump room to the boiler house, being connected by a 2½-inch copper branch to a check valve on each boiler. The hot-feed passes from the pump room to the economiser and thence returns to the boiler house, and is there connected by similar copper branches to check valves on each boiler. The injector can also deliver water into either the hot or cold feed range.

In addition to the steam dynamos there is a variable ratio motor-generator intended for use as a booster when charging the batteries from the omnibus bar. The generator side is designed for a working current of 90 amperes, with a variable pressure of 20 to 100 volts, the motor being driven at a pressure of from 220 to 250 volts.

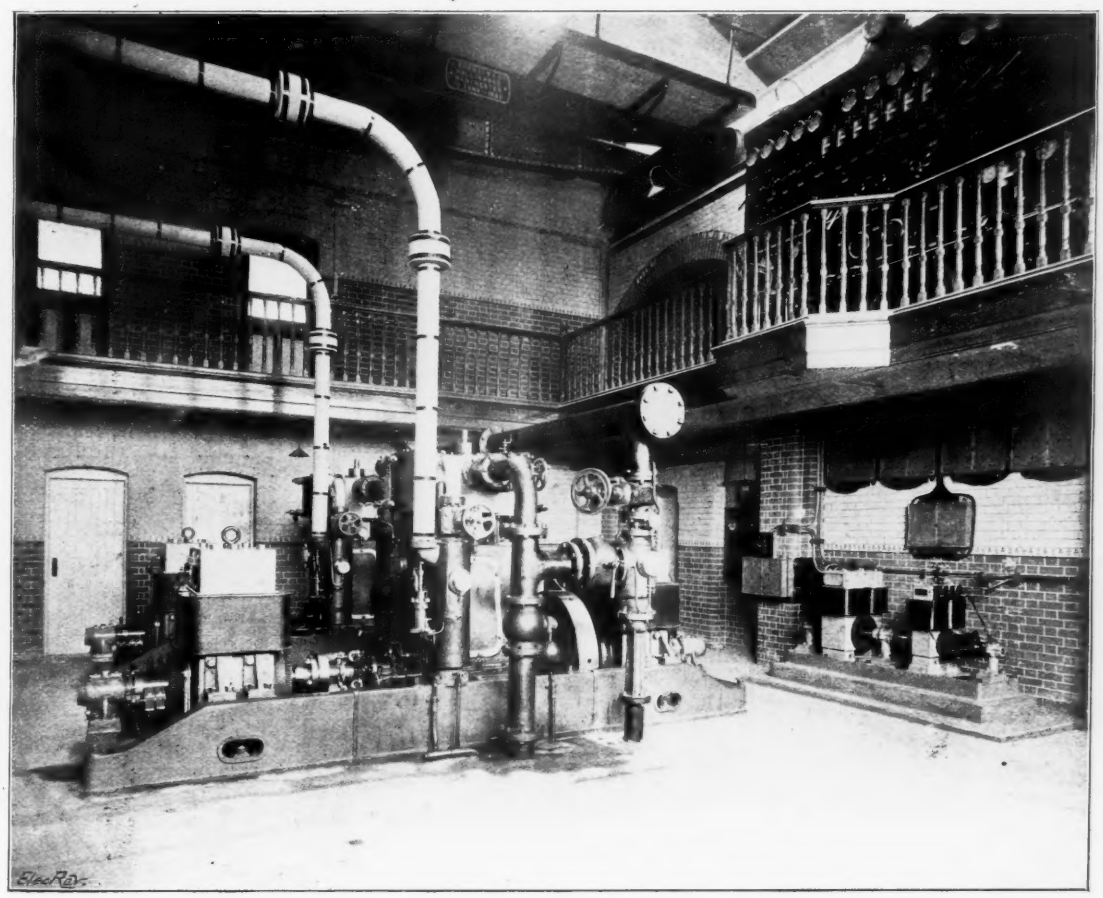
The whole of the engine house plant and pipe work has been erected by the India-Rubber Company.

An overhead travelling crane capable of lifting up to

10 tons (made by James Spencer & Co., of Wednesbury) spans the engine house, a noteworthy feature being the very limited use of cast-iron in its construction.

The accumulators were supplied by the Chloride Electrical Storage Syndicate, Limited, the cells being the well-known "R" type now used so extensively in electricity supply stations. They are constructed upon a combination of mechanical and chemical principles, combining the advantages of the Planté and Faure types of plates, lightness, durability, large capacity, and high rate of discharge, being special features.

The complete battery consists of 280 cells in glass boxes, having a capacity of 630 ampere-hours, and is capable of maintaining a discharge of 60 amperes continuously for 10 hours with a terminal E.M.F. of 500 volts. It is, however, only intended to charge 240 cells at the start, the remainder being held in reserve and for spares, and added as required. The cells rest on wooden trays supported on glass insulators, and are



Another View of Engine and Dynamo Room.

suitably arranged on stands for easy inspection. The stands are of pitch pine, and all horizontal parts are protected from acid spray by sheet lead bent along the edges in the form of an inverted U.

The connections from the cells to the switchboard are made with lead covered cable. The battery is charged direct from the omnibus bars; a somewhat novel feature of the arrangement being the position of the regulator cells, which are not fixed on the extremities as is usual, but in the centre of the battery on either side of the middle wire. The object of this arrangement is to enable all the regulator cells to be charged by one booster at the same time that the main battery is being charged.

Switch Gear.

The whole of the work in connection with the switchboard and regulating gear has been carried out by Messrs. Crompton and Co., London and Chelmsford, to the engineer's specification and requirements.

The board is divided into three sections, the positive on the right, the battery and middle wire in the centre, and the negative on the left. It is arranged for dealing with the four dynamos, arranged two on either side of the three-wire system, two batteries of accumulators with arrangements for charging the inner cells by the motor transformer, also for five feeder mains with the necessary instruments and plug bars.

The side sections are divided horizontally into three panels devoted to dynamos, plug bars, and feeder circuits respectively, reckoning from the bottom panel.

In circuit with each dynamo is placed an ammeter, and a combined duplex switch and fuse, the switch being arranged with a special sparking piece in order that its main contacts may not suffer damage should there be any current passing when the switch is operated. There is also an adjustable minimum cut-out of the well-known Crompton type.

There is a common voltmeter in the centre of the panel for the two dynamos. The centre slate contains the plug bars, which are of massive contruction, and are so arranged that either dynamo or battery may be connected on to any one of the five feeders or on to the works' circuit.

The top panel contains the five duplex switches and fuses and ammeters for the feeders. The negative side of the board is exactly similar to the positive side described above.

A sloping slate shelf at a convenient height runs the entire length of the board, and on it are mounted the shunt breaking switches and also the regulating switches for the dynamos. The two centre switches are in circuit with the motor generator, the starting switch for this being placed on the wall of the engine room close to the motor generator itself.

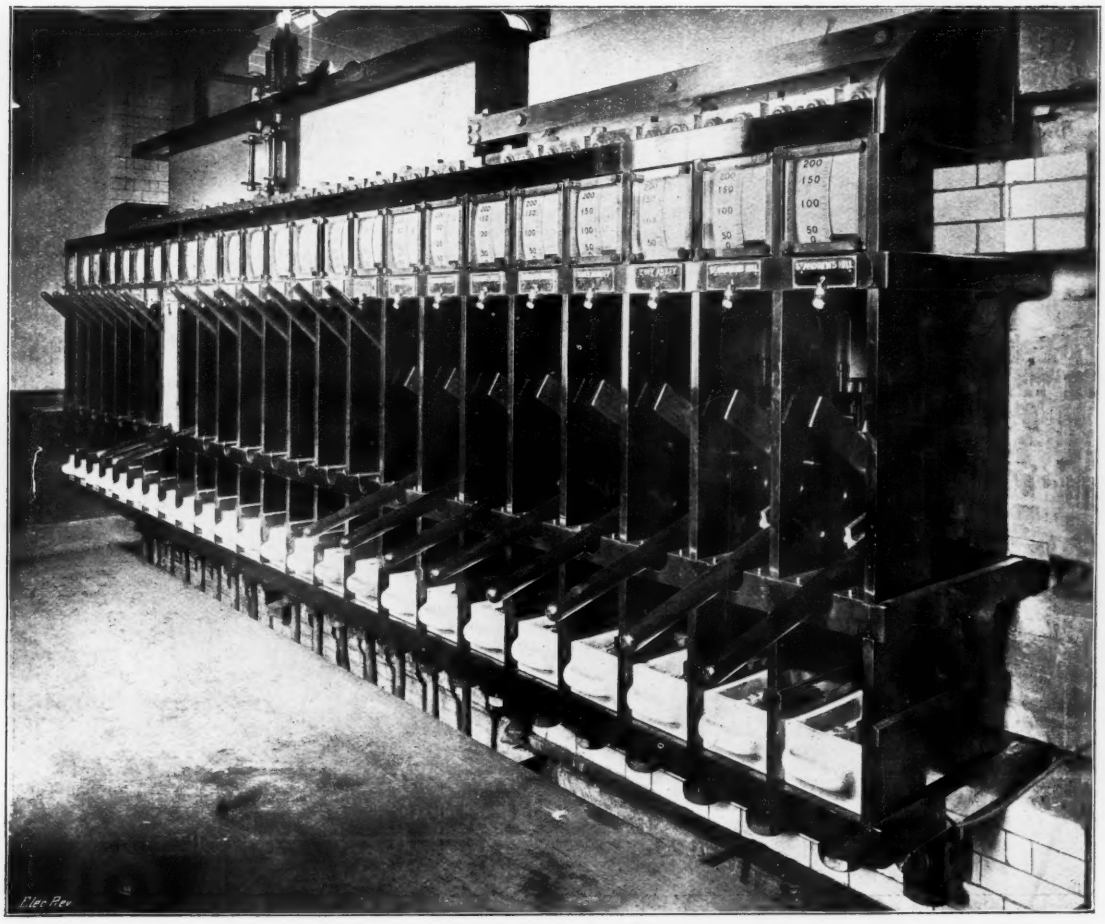
The centre section, as stated above, contains the battery gear which consists of a charging switch, the contacts of this being on the board, and a 30-way discharge switch. The handle and indicator only for the latter are on the board, the switch itself being bolted to the battery room wall, and operated from the front of the board by a long spindle.

This arrangement saves a large number of cables being carried across the space at the back of the board, and consequently the connections at the back of the board are very much simplified.

The double-pole switch shown on the right-hand panel is for the dynamo of the motor transformer, and the double-pole throw-over switch on the left-hand panel is for throwing the motor side of the transformer on to other side of the circuit for balancing purposes. The two single-pole switches shown on either panel are emergency switches in the battery circuit.

The top panel contains the voltmeters for reading the pilot, omnibus, feeder, battery and motor transformer volts, the switches for these voltmeters being placed within easy reach on the lower panels. At the top of the board are placed the two battery ammeters, the middle wire ammeter and also the ammeter for reading the charging current of the motor transformer. All ammeters on the board are of the shunted type (manufactured by Crompton & Co.), the shunts being placed at the back of the board, the voltmeters being of the well known Kelvin type manufactured by Messrs. James White.

The whole board is contained in a wrought-iron frame, the slates being held in position by bolts passing through ebonite bushes. A neat brass strip is screwed on to the front of the framework in order to hide the joints. One of the accompanying illustrations gives an excellent view of the board and gear.



City of London.—Switchboard Controlling High Tension Feeders.

The Mains.

The contract for the underground mains has been carried out by the Western Electric Company, North Woolwich. They are of the triple concentric lead-covered and armoured type laid direct in the ground.

The middle or neutral wire of the system is placed on the outer of the cable. The insulation between the inner and outer conductors is composed of paper and jute, the remaining insulation of jute only, the whole being impregnated with insulating compound and covered with lead $\frac{1}{8}$th inch thick. The lead-covered cable is then served with Hessian tapes and armoured with two steel ribbons each ·040 inch thick laid on spirally so as to break joint, and finally served again with two Hessian tapes. The distributing network, consisting of ·125 square inch and ·1 square inch triple concentric cables, is so arranged that it embraces the whole of the principal streets, making a total length of $5\frac{1}{2}$ miles. This network is fed at five points by triple concentric feeder cables, brought direct from the works to specially designed boxes together with the necessary pilot wires. Wherever possible the pilot wires have been made up forming 6-core and 9-core cable.

Disconnecting boxes of the three-way and two-way type have been fixed at various points in brick pits so that any section or sections can be fed from any of the five-feeder cables if necessary.

The house connections are made to the mains by means of the Western Electric Company's house service box of the split type, filled solid with insulating compound, and the end of the service cable is finished off in a newly designed single-pole fuse box also made by the Western Electric Company, who undertook the connection of consumers' wires to mains, the fixing of meters, and the connection of cables in the works to meter board and switchboard.

The accompanying illustrations show the laying of the mains in progress in one of the principal streets, and the connections of cables to the meter board and switchboard.

Public Lighting.

Some may cavil at the introduction into the ancient streets of Canterbury of such modern articles as arc lamps, but at

present they are used sparingly, there being only a dozen fixed in the most prominent situations. The committee, however, have adopted the extremely good principle of substituting electric incandescent lamps for gas lamps on the whole course of the mains, and when this portion of the work is completed there will be 170 posts, each containing an incandescent lamp enclosed in a Frédereau lens. So much care has been exercised over the choice of posts, that this

City of London.—Ferranti Set.

work has been unfortunately delayed, and as the posts are still in the founders' shops, no opportunity is given at present of judging of their effect, but we can say with certainty that they will be a great improvement upon the present gas arrangements.

The arc lamps which light the main street are arranged to run in one series of nine at 440 volts controlled from the works, and one series of four at 220 volts with controlling switches, &c., at the police station. The incandescent lamps are arranged to be turned off from six centres with switch boxes connecting to one of the outers of the system in the distributors, a single armoured switch wire running along each street. Each lamp, therefore, has one pole connected to the outer or neutral wire of the distributing main and the other pole connected to the special return, all the connections being arranged in a special junction box.

The lamps and pillars have been supplied and fitted up by Messrs. Crompton & Co., Limited, of Chelmsford, the smaller pillars being to a special design prepared by Messrs. James Allen, Sen., & Son, of Glasgow.

Scale of Charges.

The little pamphlet which Mr. Hammond always draws up for his works has done good service at Canterbury. The price fixed by the Corporation is :—Private lighting 6d. per unit, and power and heat 3d. per unit. The great success

that has attended the pioneer lighting is, we trust, an augury of the continued success of the undertaking, which certainly starts under better auspices than any other municipal undertaking of its size in the kingdom.

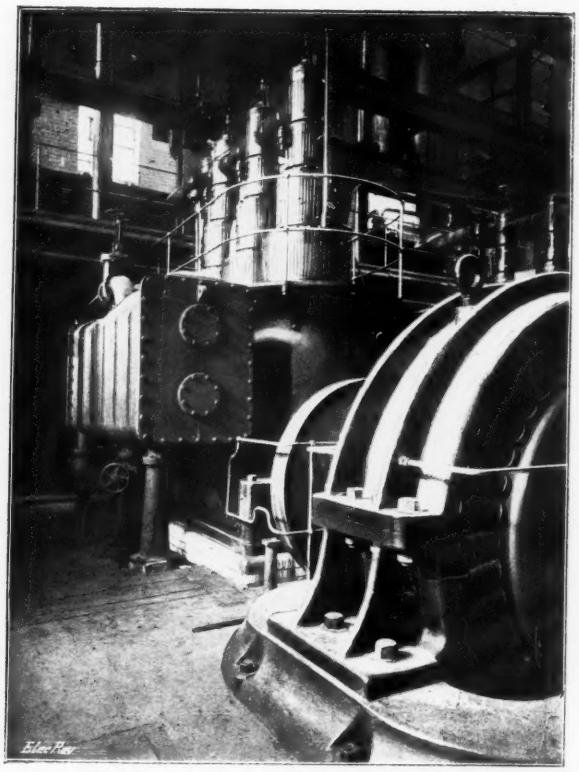
Extensions.

The specification already referred to was issued a fortnight ago and embraced the following plant :—

One Lancashire boiler 30 feet × 8 feet combined with mechanical stokers, &c.
One high speed 150-kilowatt steam dynamo and accessories.
Necessary steam, exhaust, water pipes, &c.
Condenser, centrifugal pump, motor and switch gear.
Addition to switchboard.
Addition to mains.

Had the scheme not been so bitterly opposed in its early stages, the City Council would no doubt have been emboldened to put in rather larger plant than that to which they limited Mr. Hammond, a fact which they now deplore, as there would have been a saving of money as well as space had the more generous plan been adopted. The representatives of other local authorities should take a lesson.

Finally, we heartily congratulate the Corporation, contractors and consulting engineer, on the initial success of the undertaking, and we extend our thanks to Mr. G. Spencer Hawes for his assistance in compiling the foregoing.

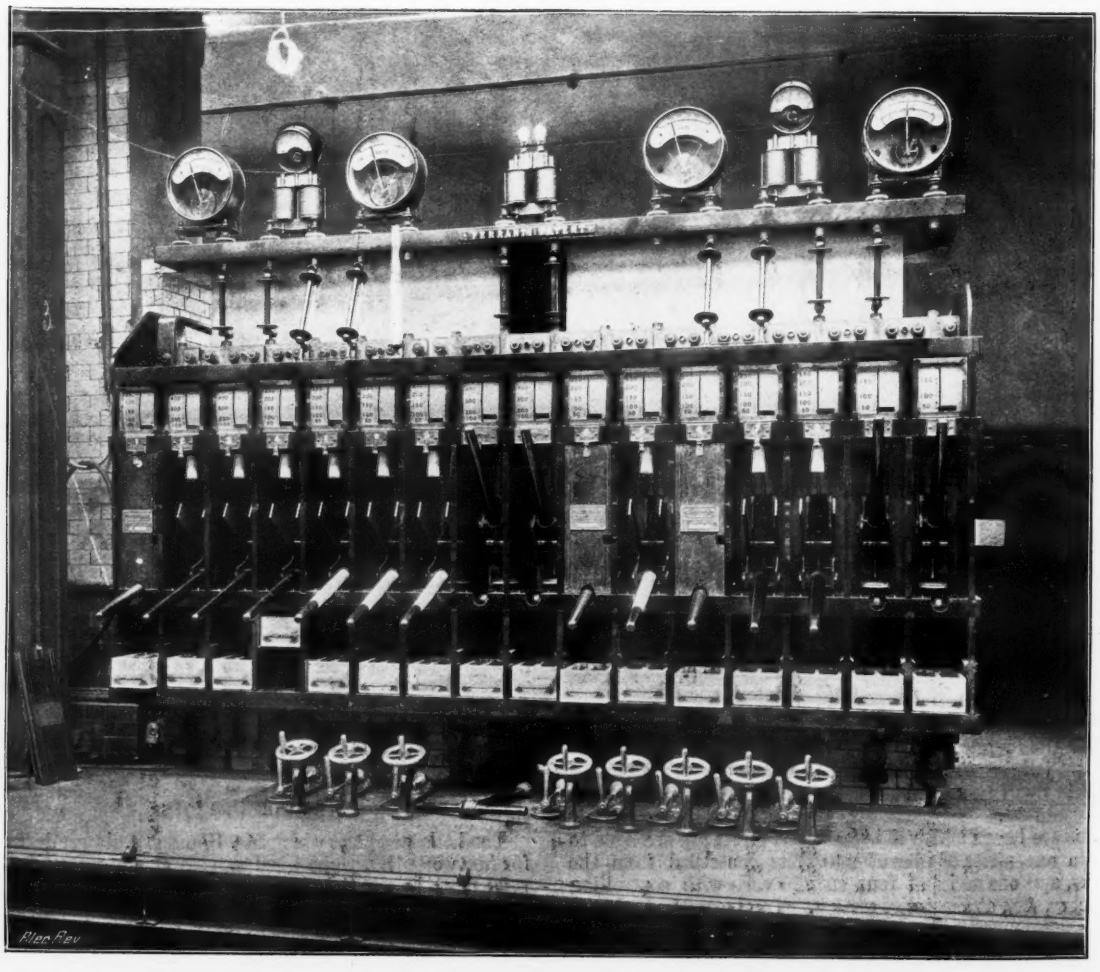


City of London.—Willans Engine and B.T.H. Alternator.

THE CITY OF LONDON ELECTRIC LIGHTING COMPANY'S WORKS.

(*Continued from page* 340.)

The original designs of the system divided the City for lighting purposes into two halves, each of which was to be supplied from two distinct works, which were to be situated at Bankside and Woolquay. Although plant was actually



City of London.—Switchboard Controlling Alternators.

erected at the latter place, it soon became evident that the most advantageous course was to centralise the whole of the plant, and eventually the Woolquay machines were transplanted to Bankside. The idea of keeping the City in two portions is still maintained and the works fall naturally into distinct sections, one half of the station supplying one district of the City and the other half feeding the remainder. The machinery is also controlled from two separate boards, and the working arrangements are so distinct that while one section of the machinery is working at full load, due to a fog over a portion of the City, the other is doing practically nothing. It must not be supposed, however, that there is no method of intercommunication between the two, for by means of interconnecting switches a machine from one portion could be connected on to the other side of the works, or when the necessity arises, such as at times of small demand, the two sections of the City can be supplied from either section of the works. There is no doubt that the conditions of supply are exceptionally difficult, owing mainly to the short space of time in which the City occasionally is enveloped in fog. There is practically, with the exception of street lighting, no summer load, yet even at the end of May, owing doubtless to a fog, the load has been known to rise within a few minutes from 1,400 kw. to 5,000 kw. Naturally, the stand-by losses of such a system must be considerable, and, moreover, would have great influence on the working costs.

In considering the City system in a little more detail, it is necessary to say that the generating plant at the moment consists of 10 Thomson-Houston generators, driven by Willans & Robinson engines; these comprising the north side of the station, while the southern section consists of Brush (Mordey) alternators, driven by Brush vertical engines, and two Ferranti fly-wheel alternator sets.

The steam generating plant consists entirely of Babcock and Wilcox boilers of the "double deck" type. Each boiler has 4,400 square feet heating surface, and is composed of 20 sections, each consisting of 19 lap-welded wrought-iron tubes 3 inches diameter by 15 feet long.

There are two steam and water drums each 48 inches diameter × 21 feet long made of steel plate ½ inch thick; these drums are surmounted by a cross drum 24 inches diameter × 8 feet long, provided with two steam nozzles 7 inches diameter.

Each boiler is provided with the usual valves, and have been tested under the usual hydraulic pressure, and are constructed for a working pressure of 160 lbs. per square inch.

The boilers are arranged in batteries. Each boiler is fitted with a Vicar's mechanical stoker, which is driven from a countershaft operated by a Bumsted & Chandler engine. Forced draught is provided for the boilers by means of a Sturtevant blower.

Above the boilers there is a large room running the whole length of the boiler house, which is used for storing and conveying coal to the boilers. The coal is picked up by a hydraulic crane and grab from barges at the river side, the grab carrying 15 cwt. at each journey, and fed into a "push plate" conveyer, which distributes the coal to the hoppers of the mechanical stokers through trap doors which are operated from the boiler house floor. In connection with this is arranged an automatic means of recording the coal consumption. At the top of the iron shute leading to the hopper is a balloon-shaped vessel which holds a ton of coal, before the coal can be released it is necessary that the balloon be full, when this is so the coal drops into the furnaces.

The waste gases from the boilers are discharged into the main flue which passes under the boilers and measures 12 feet × 10 feet, at the end of this flue there are fuel economisers, dampers are also provided to allow economisers to be cut out and the gases sent through a bye-pass into the chimney.

The feed pumps are mainly of the "Cameron" type and Weir direct acting.

The feed pipes are for the most part of wrought-iron 4 inches in diameter, and are arranged on the duplicate system. The feed water passes through the economisers on its way to the boilers.

The main steam pipes are of steel, 10 inches diameter, with electrically welded flanges. The main pipe in the engine room is carried over the top of the steam gallery, and branches are led to each boiler and engine, stop valves being placed at frequent intervals, so that sections of the pipe may be cut out. The branch pipes to the engines and boilers are 7 inches diameter and are fitted with valves; steam separators are inserted in the branches to the engines. There is a second branch from the steam drum on each boiler, which is connected through a valve to an equalising pipe carried over the tops of the boilers. Copper expansion bends are provided both in the main steam pipe and equalising pipe.

The exhaust pipes from the engines are of cast-iron, 12 inches diameter. At present the engines are exhausting into the atmosphere through a pipe carried over the engine house roof, and connected to the up-take pipe from each engine. This main pipe terminates in a water separator through which the exhaust steam passes before entering the chimney.

(*To be continued.*)

CONTRACTS OPEN AND CLOSED.

(*Continued from page* 374.)

Poplar.—The Guardians want tenders for steam turbines and dynamos (direct coupled), electric motors, accumulators, cables, wiring and fittings, distribution, and switchboards. See our "Official Notices" February 24th.

Rothsay.—March 27th. The Town Council wants tenders for 220 H.P. coupled engines and dynamos, switchboards, cables, arc lamps and posts, feed pump, steam and exhaust pipes, &c. See our "Official Notices" this week.

Southend-on-Sea.—April 6th. The Corporation want tenders for the "temporary" transfer of their 1891 Electric Lighting Order. See "Official Notices" March 3rd.

Spain.—March 16th. Tenders are being invited until March 16th by the municipal authorities of Betanzos, for the concession for the electric lighting of the public streets. Tenders are to be sent to El Secretario del Ayuntamiento de Betanzos, Spain, whence particulars may be obtained.

Spain.—The municipal authorities of Santiago are inviting tenders until April 20th for the supply and erection of the plant for a central power station to be erected near the town to utilise the water-power of the River Tambre for the generation of electrical energy for lighting and power purposes. Particulars may be obtained from, and tenders are to be sent to, El Presidenté del Consejo de Administracion Santiago, Spain.

Stockport.—March 24th. Tenders for electric lighting the Stockport Sunday School are invited to be sent in to the Secretary not later than March 24th.

Sunderland.—March 30th. The Corporation wants tenders for India-rubber covered cables, cast-iron and wrought-iron pipes and street service boxes, stoneware castings and bearers, house fuse boxes. See our "Official Notices" this week.

CLOSED.

Accrington.—On the 6th inst. the Town Council accepted the following tenders in connection with the electric lighting and destructor scheme:—Johnson & Phillips, for three engines and dynamos, £2,804 10s.; for mains and cables, W. T. Glover & Co., £4,550; storage batteries, the Chloride Electrical Storage Syndicate, £910; Crompton & Co., switchboard, £641. For bricks which will be required one contract was obtained by the Enfield Terra Cotta Company, Limited, and another by the Shaw Glazed Brick Company, of Whitebirk. Messrs. Horsfall had a tender for £5,030 accepted.

Derby.—The Council has accepted the tender of Messrs. Babcock & Wilcox for two boilers and accessories (£2,340) for the electricity works.

Doncaster.—Thirty-two tenders ranging from £6,260 to £2,500 were sent in to the Guardians for the electric lighting of the new workhouse. The tender of Mr. T. Scott-Anderson, amounting to £2,730 was accepted.

Edinburgh.—Last week the Electric Lighting Committee accepted the following estimates for the M'Donald Road station:—Mason and joiner work, Mr. James Kinnear, Edinburgh, £25,000; storage batteries, Messrs. Pritchetts & Gold, Feltham, London, £6,665; overhead travelling crane, Messrs. Carrick & Ritchie, Edinburgh, £545. It was agreed to adhere to the former recommendation of the committee in favour of the construction of a subway from M'Donald Road up Leith Walk to Picardy Place, at a probable cost of £11,000. The committee agreed to recommend the Council to put down three additional boilers at Dewar Place on the ground lately acquired.

Glasgow.—The Corporation have given an order to Messrs. Babcock & Wilcox for an additional boiler for the Springburn power station, at a cost of £942, and Messrs. T. & T. Vicars are to supply a pair of mechanical stokers at a cost of £187. Mr. D. Murray is to execute the permanent way work of the electric car route to Govanhill, south of Rutherglen Road, at a cost of £9,046 10s. 8d. Messrs. MacCartney, M'Elroy & Co., Limited, who executed the overhead work on the Springburn and High Street routes, are to provide the overhead construction required in connection with the conversion of the Govanhill line, which is practically an extension of the High Street route. The amount is £3,912 12s. 2d.

Islington.—Messrs. Patman & Fotheringham have secured the contract for the extension of the Islington Central Electric Light Station, to be completed within nine months.

Leyton.—Messrs. Oliver & Co. have lately received the order for arc lamps for lighting Leyton and district.

Liverpool.—The Council has accepted the following tenders:—Carbons, Oscar Scholzig and General Electric Company, Limited; wood casing and sundries, Simon, Berry & Co., P. Lloyd Jones, Robert Lambert, Irvin & Sellers, W. Middlemiss. The tender of the India-Rubber, Gutta-Percha, and Telegraph Works Company, Limited, is accepted for the supply and delivery of two motor generators at £980 each, and of two compensators at £380 each, subject in each case to detailed drawings and specifications to be approved by the city electrical engineer; also that of the Electric Construction Company, Limited, for the supply and delivery of two motor generators at £360 each, and of six boosters at £270 each, subject in each case to detailed drawings and specifications to be approved by the city electrical engineer.

London.—The London County Council on Tuesday considered the following tenders received for the provision of additional lines of telephonic communication between certain parts at the chief fire brigade station, Southwark:—

Private Wire and Telephone Installation Company	£53	4	6
Jackson & Coleby	97	15	0
Strode & Co.	157	0	0

The lowest tender was accepted.

London.—The contract for ventilating work, including the installation of electrical fans, at Bridgewater House, St. James's Park, has been placed with the Grabtryx Ventilating and Engineering Company, Limited, for the sum of £1,250. Messrs. O'Gorman and Cozens-Hardy acted as consulting engineers.

Lowestoft.—Last week the Town Council, acting upon the advice of a committee, resolved to accept the following tenders for electric lighting plant, &c.:—Section A., Messrs. Babcock & Wilcox, boilers, economisers, feed pumps, &c., £1,761; Section B., Messrs. Babcock & Wilcox, pipework, &c., in engine and boiler house, £660; Section C., Messrs. Musgrave & Co., Limited, steam dynamos and motor boosters, £2,833; Section D., The Chloride Electric Storage Syndicate, Limited, storage batteries, £1,534; Section E., Messrs. Laurence, Scott and Co., main switchboard and connections, £875; Section F., Messrs. Carrick & Ritchie, overhead engine room travelling crane, £265; Section G, The Callender Cable and Construction Company, Limited, underground mains and conduits for private and public lighting, road-work, &c., £8,162 10s.; Section H., Messrs. J. W. Brooke & Co., Limited, Lowestoft, arc lamps and posts, £757; Section I., Messrs. J. W. Brooke & Co., Limited, £45. Application is to be made to the Local Government Board for a £30,000 loan.

Shoreditch.—The Board of Guardians have accepted the tender (£1,330) of Messrs. Peacock & Co., Clerkenwell, for wiring and fitting up the various departments of the guardians' premises by electricity.

FORTHCOMING EVENTS.

Friday, March 10th.—At 5 p.m. Physical Society. "A Study of an Apparatus for the Determination of the Rate of Diffusion of Solids dissolved in Liquids," by Albert Griffiths, M.Sc.; "Note on the Source of Energy in Diffusive Convection," by Albert Griffiths, M.Sc.; An Exhibition of Dr. A. Wehnelt's Electrolytic Current Interrupter for Ruhmkorff Coils, by A. A. Campbell Swinton.

Saturday, March 11th.—Institution of Junior Engineers. Conversazione at Westminster Palace Hotel. Reception at 7 p.m. by the president, Sir W. H. White and Lady White; the chairman, Mr. B. H. Joy and Mrs. David Joy

Institution of Electrical Engineers. Students' visit to the Davy Faraday Research Laboratories of the Royal Institution at 11 a.m.

Wednesday, March 15th.—At 7.30. Institution of Electrical Engineers. Students' meeting. Paper on "The Application of Electric Motors to Printing Presses," by E. V. Young.

Thursday, March 16th.—At 2.30 p.m. Institution of Civil Engineers. Students' visit to the generating station of the South London Electric Supply Corporation, in course of construction.

Saturday, March 18th.—At 11 a.m. Institution of Electrical Engineers. Students' visit to the Langdon-Davies Electric Motor Company. Meet at the works, 101, Southwark Street, S.E.

THE VICTORIA ACCUMULATOR.

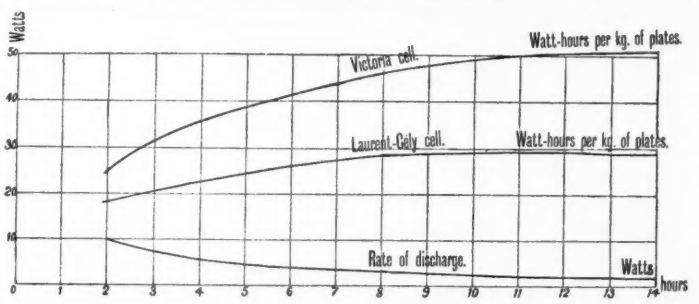
The results shown in the following figures are those of tests made by Mr. G. J. Gibbs, of Bradford, Mr. C. E. Spagnoletti, the late Mons. R. Seppey, of Paris, and also at the School of Chemistry and Electricity, of Paris, upon the Victoria secondary battery, which is being constructed by the Eclipse Brass and Copper Company, Limited, at Halifax.

The Victoria accumulator, in its present form, is the outcome of many years' experience.

The chief features of the accumulator are:—

1. The active material is a special compound of lead salts with organic matters. One of the chief characteristics of this active material is the high E.M.F.—for instance, on a 7-hour discharge the E.M.F. keeps up to two volts for half the time. The material is remarkably cohesive and at the same time absorptive, with high conductivity giving a low internal resistance. The chemical reactions are very complicated, and are dealt with at length in a report by Dr. Knorre, Professor of Electro-chemistry of the Imperial Technical School, Berlin. The capability of this active material for standing extremely high charges and discharges without structural deterioration is said to be remarkable. Its "current-retaining properties" are also claimed as being very great. A battery in use for carriage lighting remained at over two volts for nearly two months. Cells despatched to the Continent for testing showed 2·15 volts on arrival, after a long railway journey on each side.

2. The supporting plates are of a special manufacture and construction, the active material being securely locked in the plates,



which at the same time possess the requisite flexibility, and are buried in the active material, thus being kept free from direct oxidation.

Cast grids are in this accumulator entirely abolished, the supporting plates being formed out of thin rolled lead; ensuring lightness, conductibility, and are yet of extreme strength and toughness. Their manufacture by special machinery is cheap and rapid.

As a consequence of the combined effect of the new paste composition, and the novel form of grid, it has been found that a smaller number of plates are required for any given capacity, as, for instance, a cell 11 inches high × 7 inches × 4 inches, containing only nine plates, has a capacity of 37 watt-hours per kilo of plates at the rate of discharge of 3·3 watts per kilo of plate.

The following diagram exhibits the curves of capacity in watt-hours for a given rate of discharge in watts per kilo of plates.

By looking at the diagrams it will be found that:—

Rate of discharge.	Corresponding specific energy.
2 watts.	50 watt-hours.
3 „	45 „
4 „	40 „
6 „	35 „
8 „	30 „
10 „	24 „

These figures speak for themselves.

Dimensions and Weight of the Elements.

Number	of negative plates	5
	of positive „	4
Receptacle	length, external	7 inches.
	width, „	4 „
Receptacle	height, external	11 inches
	width, „	6½ „
	height	8¼ „
	area, both sides	108 sq. ins.
	total positive surface in cell	3 sq. ft.

Weight	six positive plates	11 lbs.
	seven negative plates (including end plates)	12½ „
	plates in one cell	23½ „
	„ receptacle, electrolyte and connections	31·5 „
	total of 44 cells	11 cwt. 54 lbs.

The specific energy when the rate of discharge of the cell is 70 watts is 368 watt-hours, and the weight of the cell is 31·5 lbs., including the electrolyte and the two-fold connections. Various data relative to this rate of discharge are given below:—

Rate of Discharge, Power, Capacity, &c.

Normal rate of discharge (amperes)	per square inch of active positive surface	7
	per positive plate... ...	6·8
	„ lb. of cell	·85
	„ cell	27·2
Electromotive force per element		1·99
Normal power (watts) ...	per lb. of plate	2·3
	„ „ cell	1·7
	„ cell	53·8
Specific energy (watt-hours)	per lb. of plate	17·4
	„ „ cell	13
	„ cell	408
	„ 44 cells ...	...17,952
Energy in H.P.-hours per 44 cells		24
Weight per kilowatt (lb.) ...	plates	438
	cell	586
Weight per kw.-hour (lb.) ...	plates	57·5
	cell	77·1
Weight per H.P.-hour (lb.)	plates	50
	cell	70

The company manufacture for electric traction, batteries of a lighter kind, as well as for lighting purposes.

NOTES.

Wehnelt's Electrolytic Interruptor.—At the meeting of the Elektrotechnishe Verein on February 22nd, Kallir and Eichart gave an account of experiments which they had made in working an induction coil with Wehnelt's remarkable device, from an alternating circuit. It has already been shown that a coil can be worked successfully from continuous current mains with Wehnelt's interruptor, and it was supposed, owing to the extreme frequency of the breaks, that it might also be possible to work the coil with commercial alternating currents. This surmise has proved to be correct. The frequency of the currents in the Vienna network, to which the primary of the coil was connected up, is 84 per second. Sparks of the full length given by the ordinary break and condenser were obtained with the Wehnelt interruptor and the alternating currents. Apparently the secondary discharge takes place only during a part of the half period, *i.e.*, the E.M.F. has to reach a certain minimum amount before any effect is produced. These results will extend the field of usefulness of this remarkable invention still further. Mr. Campbell Swinton's paper on this subject at the Physical Society to-night is awaited with considerable interest.

Staff Dinner of the British Insulated Wire Company.—The staff dinner of the B.I.W. Company, which was held last Friday at the Adelphi Hotel, Liverpool, was as successful as most of the ventures with which this company is associated, which is saying a good deal. Mr. Brigg presided over the gathering, and besides the engineering and clerical staff, there was a large number of visitors, many of whom travelled specially from London. There were some interesting toasts, not the least in importance being that of the electrical industry, which was most ably responded to by Mr. S. Z. de Ferranti. That of the company was proposed by Mr. Nisbett, and replied to by the chairman. Next day many of the visitors journeyed to Prescot and viewed the large extensions which have been recently made to the works.

The Electric Lighting of the Houses of Parliament.—The Civil Service estimates relating to public work and buildings give the lighting bill of the Houses of Parliament for the coming year as £4,950, £3,300 of this being for electric current and £1,650 for gas.

Institution of Electrical Engineers.—The first interim report (dated February, 1899,) of the committee appointed to consider the question of uniformity in electrical engineering practice states that the committee has given very careful consideration to the question of the adoption of a uniform standard of frequency or periodicity in alternate current working. It has collected information and has ascertained the opinions of a number of manufacturers and of consulting engineers on the Continent and in America, as well as in this country. It is unanimous in recommending the adoption, for general purposes, of a frequency of 50 periods per second, as, on the whole, the best suited to ordinary cases of mixed distribution of alternating currents for glow lamp, arc lamp, and power supply. For the exceptional purposes of transmission of power on the large scale it recommends the standard frequency of 25 periods per second. It also suggests for the exceptional cases of house-to-house transformer supply as preferred in districts where the houses are scattered a standard frequency of 100 periods per second.

Polyphase Machinery.—With reference to Mr. A. C. Eborall's course of lectures on "The Design of Polyphase Machinery" at the Finsbury Technical College, we understand that the class was filled some days before the course commenced, and a considerable number of applications had to be refused. The interest evoked by the announcement was not confined to London, as men from engineering centres in Kent, Essex, and Lancashire are in attendance. May we not take this as an indication that the insular prejudice against polyphase machinery is on the wane?

Presentation.—Mr. H. Collings Bishop was on Sunday last the recipient of a very handsome chiming clock, presented to him by the staff of the Leyton electricity works on his leaving to take up the position of borough electrical engineer at Wigan. The presentation was made by Mr. Musgrave, the chairman of the Electric Lighting Committee, on behalf of the engineers and staff.

Birmingham Trams.—The City Council on Tuesday decided practically unanimously to take over the whole of the city tramways as the leases fall in (some three years hence and others 12 years) and work them themselves.

Yorkshire College.—On Saturday last the Yorkshire College students held their first conversazione. Wireless telegraphy and Röntgen ray demonstrations, as well as an exhibition of electric lighting and heating apparatus by the Edison & Swan Company, formed part of the proceedings.

London Chamber of Commerce.—On Wednesday afternoon Mr. B. H. Thwaite, C.E., addressed a special meeting of the London Chamber of Commerce on "Home and Foreign Railway Rates for Goods Traffic."

Appointment Vacant.—The Barnsley Corporation want a competent electrical engineer as clerk of works for carrying out the construction of the electricity works.—(See our "Official Notices.")

New Journal.—Messrs. Cordingley & Co. are about to bring out a new penny weekly to be called the *Motor Car Journal*.

Royal Institution.—The discourse this evening is on "Measuring Extreme Temperatures," by Prof. H. L. Callendar, F.R.S.; that on March 17th is on "The Electric Fish of the Nile," by Prof. Francis Gotch; and that on March 24th on "Transparency and Opacity," by Lord Rayleigh.

Across the Border.—The Vestries of Islington and St. Pancras—both suppliers of current—have come to an arrangement for connecting electric light to premises overlapping the border line of the two parishes. The Islington Vestry has agreed to allow the St. Pancras Vestry to take up the footways in the Brecknock and York Roads and lay electric mains along same, although these thoroughfares are in the former parish.

Lectures.—At a meeting of the Chester Caledonian Association, Mr. J. R. Thomson lectured on "A Chat about Electricity."

Prof. W. F. Pullen on the 4th inst. read a paper on "Furnaces and Smoke Prevention" before the Sanitary Inspectors' Association at Carpenters' Hall, E.C.

Mr. W. C. C. Hawtayne, M.I.E E., was to read a paper upon "The Progress of Electricity Supply during 1898, with some Notes on Electric Traction and Motive Power," at the meeting of the Bishopsgate Ward Club on Wednesday.

At the Bradford Temperance Hall on Sunday, Mr. H. B. Knowles lectured, under the auspices of the Bradford Sunday Society, on "Electricity: Some of its Uses."

Coherers.—Prof. Lodge, lecturing on coherers at the Royal Institution, defined the coherer as the analogue of the microphone, the former being affected by electric waves in much the same way as the latter is affected by sound waves. He expressed surprise that people nowadays take so much interest in wireless telegraphy, seeing that 100 years ago it was the only kind of telegraphy. The heliograph, which is still extensively used in Imperial warfare on the outskirts of the empire, is essentially a system of wireless telegraph. Prof. Lodge thinks it is electric wireless telegraphy, and five years ago he put forward a theory that the eye was a kind of coherer, but he had failed as yet to prove this to physiologists. Some interesting experiments were shown illustrating the effect of electrostatic induction on masses of fine particles. Rayleigh showed some years ago that a jet of liquid which had broken up into particles, could be again made continuous by the presences of an electrified body. Other experimenters have since shown that contiguous drops of mercury under oil can be made to unite in this way. A Scotch mist can be converted into rain, and fumes of most kinds can be precipitated. But he has no hope that the electric charge will have any favourable effect on London fogs; he thinks the exclusion of coal, and the introduction of our fuel in the form of gas would be far more effective. But he appears to have forgotten the fact proved by Aiken, that the combustion of gas produces quite as much of the fine dust that forms the nucleus of fog as the combustion of coal. Prof. Lodge showed several other striking experiments in connection with his subject. For instance, two soap bubbles were arranged side by side, so as to be almost in contact; when struck by an electric wave, the bubbles rushed together and united, so as to form one large one. In another experiment it was shown that a chain of filings could be lifted at the end of a metal rod when an influence machine was at work in the neighbourhood.

Vacuum Drying of Dynamos and Motors.—In Germany the leading electrical firms are said to dry their insulations at a low temperature by means of a vacuum. Placed in vacuo, water evaporates at correspondingly low temperatures. In a vacuum of 28 inches, for example, a temperature of 35° C. (95° F.) will soon dry off any moisture, and even at 63° F. very thorough drying can be effected in a good vacuum, as a glance at a table of the properties of steam will render obvious.

Smoke Nuisance.—Sir W. B. Richmond sends to the *Times* a copy of the first circular of the newly constituted Coal Smoke Abatement Society, setting forth the objects thereof. It is intended to aid in enforcing the existing law, and to obtain amendments in it. But a more laudable object is expressed in the intention—

To inquire into the present causes of the smoke nuisance and the best means of removing or lessening the same, and to promote the investigation of appliances designed with that object. To obtain evidence of the methods of dealing with smoke at home and abroad. To promote the knowledge of methods by which the emission of smoke may be prevented, and for that purpose to encourage the organisation of exhibitions and to stimulate invention by the offer of prizes.

General Post Office.—We understand that Mr. Martin F. Roberts, superintendent of the Postal Telegraph Factory, Mount Pleasant, has been appointed to the position of second assistant engineer-in-chief, in the place of Mr. J. Gavey, who was recently promoted to the position of first assistant engineer-in-chief and electrician, General Post Office.

Personal.—Mr. F. R. Batty has resigned the post of manager for the National Electric Free Wiring Company's Bradford branch, in order to accept the position of general manager to Messrs. Donnison, Barber & Co, 10, Corporation Street, Manchester.

Mr. E. Stanley Franklin is leaving Colchester, where he has had charge of the erection and running of the municipal electricity works, in order to take supervision of the erection of the plant for the experimental trains on the Metropolitan Railway. Mr. H. R. Sillar, until recently engineer at Blackpool Winter Gardens, will succeed Mr. Franklin as Messrs. Siemens's resident engineer at Colchester.

Mr. William H. Marshall, lately with the Westminster Electric Supply Corporation, has just been appointed to the staff of Mr. A. H. Preece.

Repetition of Mr. Marconi's Demonstration at the Institution of Electrical Engineers.—We are informed by the secretary that as a very large number of members and others failed to gain admission to the meeting on March 2nd, Mr. Marconi has kindly promised, at the request of the Council, to repeat his lecture and demonstration on Thursday, March 16th, but at the time of going to press the place of meeting is uncertain owing to the very large demand for tickets. Up to 7.45 p.m. admission will be only by tickets, to be obtained by members on application to the secretary.

The Explosion at Barking.—The Board of Trade inquiry into the Barking explosion took place on the 28th ult. at the Town Hall, Barking. It appears from the report that the inspector has arrived at the conclusion that one valve was loaded down to 242 lbs. and the other to 257 lbs. A coincidence was mentioned in evidence that the pointer of the steam gauge if the stop pin was removed went forward to 15 lbs. on the second round and then stopped, the inference being that possibly the finger had slipped over the pin, and, therefore, stood steadily at very near the 16 lbs. which has so often been named as the gauge pressure during the inquest, and, curiously, this would correspond with a pressure of 235 lbs. The witness stated that he had heard that the gauge pointer was found at the wrong side of the gauge pin after the explosion. The pressure of 15 or 16 lbs. was apparently a noticeable thing, so many seemed to have specially taken this into account. This points to the probability that there was some surprise at the pressure not being higher. Mr. Ed. Atkinson could only account for the gauge reading on one of two theories, both of which we have already advanced, namely, that the gauge was either choked or otherwise held, or that it was on the second round and had reached its limit of travel. Mr. Atkinson considered that the boiler was safe at 50 lbs., and had held over 200 lbs. Mr. Carlton, of the Board of Trade, also calculated a probable 240 lbs. pressure. The finding of the Board of Trade Commissioners was given on Saturday, March 4th. It was to the effect that the boiler was sound, but had exploded from over pressure; that the fault was that of the late Mr. Burners, who was killed, and that Messrs. Hewett were responsible for his negligence and must pay half the cost of the inquiry. It is a lame and impotent conclusion. First they say that Mr. Burners had the qualifications and necessary experience to enable him to adjust the safety valves, and then they say Messrs. Hewett are to blame for not having properly qualified managers. Yet we presume Messrs. Hewett had appointed Burners, who is held to have been competent. Surely it is no fault of Messrs. Hewett that he made a mistake?

CITY NOTES.

Chelsea Electricity Supply Corporation, Limited.

The annual ordinary general meeting of the above company was held on Monday at the offices, Cadogan Gardens, S.W., Mr. J. Irving Courtenay (chairman) presiding.

In moving the adoption of the report, the Chairman said the board recommended a dividend of 6 per cent. for the year, which was at the same rate as that of the previous year, but on a capital larger by £40,000—the amount of the last issue of ordinary shares. Though there was no increase in the dividend, they had been looking ahead

and seeking to consolidate the position of the company. A matter of great interest in their work in 1898, and of much benefit for the future, was the passing of the Act for the compulsory purchase of land. They might recollect that when he had the pleasure of meeting them last year he said that it was reasonable that electric light companies having statutory obligations to the public should have powers to enable them to duly perform those obligations, and he was glad to be able to say that Parliament had confirmed that view. A Joint Committee of the Houses reported in favour of the principle of compulsory purchase, and the Bill passed successfully through each House. A mass of evidence was given for and against, and they were strongly opposed by local authorities and by those who had private interests to subserve, but the Commons' Select Committee, through its chairman, declared that, upon the evidence, the committee was satisfied that the company's present powers did not, and the additional powers given by the Bill, would not, if used with due and reasonable care and skill, and by means of modern machinery and appliances which the company might be reasonably required to employ, cause any sensible physical damage to the structure of the buildings in which the petitioners had interests, or any such discomfort to occupiers of these buildings as might be reasonably complained of by such occupiers. The result of the passing of this Act, the first of its kind, was not only to give them powers to purchase sites necessary for their stations at reasonable figures, but also to free their works and operations from the hardship of what was commonly known as the nuisance clause of the provisional order, under which the production of electricity was liable to be stopped by a private owner or resident through an action at law, although they might be using the best known method of working and the newest and most scientific appliances. It was now necessary for a complainant to show that they were not exercising reasonable care and not using the best known methods in their machinery. One immediate effect was the satisfactory settlement of an action brought by a resident which had been hanging over them since 1897, and it had enabled them to proceed with their Alpha Place generating station. In connection with the procedure of the Parliamentary Committees, he might also mention that the question of Vestry competition was satisfactorily dealt with. The decision in regard to the Marylebone Vestry, whose Bill was thrown out, showed, he thought, that Parliament disapproved of competition by a vestry, which, by declining to do the work itself, and consenting to a company's provisional order, had practically given the company a lease of 42 years, unless, of course, the company neglected its duty and did not fulfil its obligations. The Chelsea Vestry, for some occult reason, had not manifested towards them that spirit which they had a right to expect from a public body whose parish had largely benefited from their operations, but their action would have no effect on the conduct of their business in the interests either of their customers, the public, or their shareholders. The directors had under consideration various plans with the object of bringing the advantages of the electric light within the reach of those of the public who were able to use it only on a small scale and who also desired to spread the capital outlay over several years. He had dealt at length with these matters because they were of vital importance and now he passed on to the financial situation. The business of the company was steadily increasing, there having been an increase of nearly 16,000 lamps of 8-candle-power, or their equivalent, during the year. The revenue had not increased in the same proportion, owing mainly to the fact that the two winter quarters were exceptionally bright and fine, while consumers, who evidently lived and learned, practised economy. The revenue per lamp during 1898 was just under 5s. 7½d., whereas during 1897 it was 5s. 9½d., the lamps in 1898 using an average of only 11½ units each; thus from these causes there was a reduction of current used per lamp in the year of over 2d. per lamp. This was the main difficulty they had to contend with in the supply in Chelsea. In consequence of such a large number of the most important houses remaining unoccupied, except during the London season, the average amount earned by each lamp was very low—the lowest, he believed, of any of the London supply companies. The working costs for the year under review did not show any diminution: indeed, there was a small fractional increase, but this was largely due to the reduced consumption, and also to the extra cost of fuel, consequent on the South Wales coal strike, and the fact that their fuel economising arrangements had been delayed in delivery, as the result of the engineers' strike. There was also a small increase in the wages' account, which, in those days, one seemed always to expect. Of the whole capital expenditure nearly £100,000 had been spent in land and freehold and leasehold buildings. They could not have a better security, for they were rising in value. A good deal, however, of this expenditure was not by any means so productive as it would be. Some of the land was not yet occupied by their works, and some of the buildings were scarcely occupied by machinery, while in others there was room for much more machinery. They had erected and were constructing and equipping distributing sub-stations of dimensions large enough to supply the maximum demand expected in their respective districts—such as Pond Place, Carlyle Square, and Smidburn Street sub-stations, and they have carried out various extensions of the mains, including the western portion of the parish. Again, the accommodation for meter testing, repairing shops, stores, general offices, and residence for assistant engineers at Alpha Place generating station would, when that station was completed, suffice for any extension of business in their own district for many years. From this it would be seen that some considerable portion of the capital expenditure must be considered as at present not earning its quota, and that the further increase of demand should be supplied at a reduced capital cost. The balance of premium on issue of debenture stock, after deducting costs of issue and various other special charges, had been added to reserve fund, which now stood at £46,818 3s. 4d. For the reasons given, he considered the position of the company was stronger than ever it was, and that they might anticipate increased prosperity. He moved:—"That the report of the directors and statement of accounts for the year 1898 now before this meeting be and they are hereby adopted, and that the payment of dividends of 6 per cent. on the preference and on the ordinary share capital of the company for the year 1898 be and is hereby approved, the dividends to be payable forthwith."

Major-General Webber seconded the motion, and said that one thing the chairman had not mentioned was the prominent part the chairman and staff had taken in getting the Bill through. He considered the passing of that Bill had given them a new lease of existence. It was a struggle which was inevitable on the part of one of the London companies, and, curiously enough, it fell to the Chelsea Company—which was the oldest company—to make the fight.

Mr. Young asked with regard to the reserve fund account to which the sums of £910 "expenses on issue of shares and debenture stock," and £1,769 "exceptional expenses" were paid.

Mr. Dawes complimented the board on the large reserve fund, but asked how it was invested.

Replying to these and other questions, the Chairman said the reserve fund was invested wholly in the company's business, and had thus prevented further capital being issued. They had taken the advice of eminent counsel with regard to the founders, and they were advised that they had acted correctly with the sums at their disposal. He looked forward to increased prosperity, and then they would pay a dividend to the founders.

The motion was then carried.

An extraordinary general meeting was subsequently held to consider, and, if thought fit, passing resolutions authorising the increase of capital by the creation of 40,000 ordinary shares of £5 each, and the alteration of several articles of association.

The Chairman said they would see from the accounts that all the authorised share capital had been issued, and they had issued debenture stock to the extent of half the subscribed share capital. They had powers to issue debenture stock up to the full amount of the subscribed share capital, but would rather hold those powers in reserve in case of emergency. The further issue of capital would depend upon the demands of the business, probably the latter part of this year or beginning of next. In regard to the elimination of the operation of Clause 4 of the articles, that method was adopted when they last increased the capital. Clause 4 provided that new capital should be offered to existing shareholders in proportion to the shares held by them. Now, this was not a perfectly satisfactory method, because if the whole issue when thus offered was not taken by the shareholders the public were not so likely to readily apply for the remainder. It was also beneficial to the company to have its shares more widely held, especially by the Chelsea public.

Mr. Makins moved as an amendment that the new shares be issued *pro rata* to the shareholders.

Mr. Young seconded the amendment.

After some discussion, the board accepted the amendment, and the resolution to increase the capital as so amended was carried.

Notting Hill Electric Lighting Company, Limited.

The twelfth ordinary general meeting of the above company was held at the offices, High Street, Notting Hill, on Wednesday night, Sir William Crookes presiding.

The Chairman, in moving the adoption of the report and accounts, said they showed the continued and increasing prosperity of the company. The share capital account showed no change during the year. The loan account showed that £31,000 of first mortgage debentures had been issued, of which £26,000 had been paid, bringing the total share and loan capital received to £126,000, and an additional £5,000 had been taken up since the close of the year, leaving £19,000 for future issue. The total capital expenditure was £128,003 19s. 4d., or £2,003 19s. 4d. more than the capital received. The largest item of the expenditure had been for new mains. They had laid mains in many streets for the purpose of opposing provisional orders applied for by other companies. Nevertheless, their gross revenue was over 10 per cent. on the capital expenditure of £128,000 and they considered this rate amply justified any extension, leaving future developments to bring increased profits. The item of £3,671 11s. 8d. for new machinery included the cost of a new boiler, engine, and dynamo, which practically filled the whole of the available space at the works; they must erect another station to cope with the increasing demand for electricity. The item of £4,060 16s. 7d. for buildings was principally the cost of the freehold of the building in which they are holding the meeting, it was purchased at the almost unanimous wish of the shareholders at the last meeting, in consequence of the old offices being required for instruments and light machinery. With regard to the debit side of the revenue account the expenses had increased in one or two cases over the corresponding period of the previous year. The cost of coal naturally increased with a larger output, but there had been an exceptional increase in this item last year. The cost of renewals to the accumulators was considerably increased, and amounted to £490, but the directors thought it advisable to charge the whole of this to revenue account rather than take it out of the renewal fund. In fact, the whole of the buildings, plant, and machinery had been maintained in an efficient state of repair entirely out of revenue account. There was also an item on this side of the account of £119 10s. 7d. for law costs. These had been incurred in opposing applications to Parliament for powers which might have been competitive, and further, the company joined with several others in opposing the Marylebone and Bermondsey Vestries' application for powers to compete with the electric lighting companies already supplying current in their parishes. It was considered most

advisable to give uncompromising opposition to these applications, as had Parliament granted the orders it would have created a precedent enabling the local authorities to supply electricity in competition with companies to which they had practically given a lease, and it was on the moral understanding that no competition would be allowed that many shareholders were originally induced to invest their money in electric lighting undertakings. He was glad to say the Bills were thrown out by the Parliamentary Committee. On the credit side of the account the receipts had increased over those of the previous year by nearly £2,000, and had it been possible to avoid a reduction in the price per unit they might now be in a position to recommend a much larger dividend. The pressure brought to bear by the local authority and the possibility of competition had made it necessary to keep the charge for current as low as possible, and the meter rents had also been reduced 50 per cent. The profit on the year's working was £7,251 13s. 7d. Although the increase in the profit on the revenue account was small the number of houses and lamps connected during the last year created a record compared with any previous year of the company's existence. Many of these, however, were not connected until late in the year, but they would feel the full benefit of the increase during the current 12 months. Looking back for a moment before looking forward, he might remind them that they had had an exceptionally light season and the output during the summer months was no larger than the corresponding period of the previous year, although their customers had considerably increased. They could see by the office they were in that the company was now in a good position in the district, mains were being extended in all directions, and new customers were being rapidly connected, so that the present output was most promising. More than two-thirds of their customers were already being supplied at the higher pressure of 200 volts, and as soon as they were all converted the saving in the cost of distribution would be very considerable, and would allow them to connect a much larger number of customers to the present mains. The chairman concluded by moving the adoption of the report recommending a dividend of 6 per cent.

Mr. Franklin seconded the motion and it was agreed to.

An extraordinary meeting was held to confirm the resolution passed for the approval of the Kensington and Notting Hill Electric Lighting Bill now before Parliament.

The Chairman showed the need there was for another station, and explained how the two companies had agreed to unite in building one, and before doing so they had made an arrangement with the Kensington Vestry which would practically do away with competition. The land on which the station was to be erected was at Wood Lane, Hammersmith. The directors considered that this arrangement would strengthen and benefit the company, and they had been assured that the Vestry would certainly not give their consent to any application for a competing order in the district, and as they had now come to terms with them to carry out the public lighting, it was extremely unlikely that they would apply again for a provisional order themselves. A considerable amount of new capital would, of course, be required for the purchase and erection of the joint generating station, and the present intention was to have a separate capital in the form of a joint guaranteed stock, the two companies to pay for current which they took at prime cost, after providing for the sinking fund, which would redeem the whole of the capital in 31 years, the station to belong to the companies in proportion to the amount paid by each. The consequence would be that when the time arrived when the local authority would buy them out their interest in this neutral property would not only ensure them against any under valuation of their shares but would enable a handsome bonus to be declared. In the commencement the Kensington Company would require more current than themselves, and consequently would invest more capital in the concern, but as their mains extend in the north and other parts of the parish (as they must under the present contract with the Vestry), they would in time perhaps be the preponderating partners in the concern. At present it was the intention to publicly light only those streets where mains are already laid, but as soon as the joint station was completed they would be able to connect the other more outlying districts.

The resolution was adopted.

City of London Electric Lighting Company, Limited.

The ordinary general meeting of the shareholders of the above company was held on Wednesday last, at Winchester House, Old Broad Street, Sir David L. Salomons, Bart., presiding.

The Chairman, in proposing the adoption of the report, after alluding with regret to the loss the company had sustained in the death of Lord Suffolk, said he dare say that many shareholders would be anxious to learn why it was that they declared a dividend of 4 per cent. less than they did last year, and some might even imagine that a kind of crisis had come about in the history of the company. But he trusted that after he had given them the facts in the frankest possible manner they would see that such was really not the case, and that the future of the company was really assured. It must still be fresh within their memories that not long back they granted powers to the board to increase the ordinary share capital, and that was done to the extent last year of £200,000. It was evident that that capital during the past year was not bringing in any appreciable return to help the revenue. Up to 1897 it had been customary to charge a portion of management to capital expenditure, but last year they considered that that method should come to an end, and therefore the whole of the management had been debited to the revenue account. The board also considered, from the peculiar circumstances of the case, and from the conditions which surrounded the company, that the maximum price of 8d. per unit should be reduced to 7d. within the City area, and nothing had occurred to alter their views in that respect. The applications for connections had increased considerably last year over the preceding years, which showed that the public fully appreciated the boon which they had conferred upon them by a reduction in price, and it must also be remembered that the first year's working of reduced charge told much harder against the concern than it was likely to do in future years. As compared with many years, 1897 was particularly bright, and that had, unfortunately, acted against them, because so much light was not used as in foggy or dark weather. Then, again, coal rose in price appreciably during the past year, which had added to their expenses. Had the dividend for last year been the same as the year before, they would have had to have gained a net profit of £22,000 in order to pay it; also had the ordinary capital remained the same last year as in the previous year, instead of 6 per cent. being declared it would have been 7½ per cent. The greatest novice at business knew perfectly well that when capital was being expended they got no interest for the money unless they were supplied with Parliamentary powers for the payment of interest out of capital, which did not apply in their case, consequently the spending of that money last year which they supposed would bring them in good results for the future was a load upon them rather than an advantage so far as 1897 was concerned. As to the future prospects, on many occasions he had told them that the time would arrive when the Wool Quay site, which had proved to them a white elephant, would prove to be a most valuable property if they could only get suitable tenants. He was pleased to say that that site had now been turned to good account. The ground rent was £4,000 a year, and the bulk of that would be taken off their shoulders as from March 1st. They had expended a considerable amount in erecting buildings suitable for a shipping company on that site, and in addition to the £4,000 ground rent they would receive a return upon the capital expended on those buildings. Various small alterations in details were being made at the works with a view to greater economy in the production of electrical energy, and he thought if a comparison was to be made with any other company in London it would be found that they were producing the energy at as low, if not at a lower price than any of their neighbours, which was due to the great experience of their engineer. The generation and distribution cost per unit last year was 1·6558d., as compared with 1·6407d. in 1897, the slight increase being due to the increased cost of coal; and the cost per unit of generation, distribution, rent, rates, taxes, and management was 3·3011d. in 1897, while last year it was 2·6293d. These figures in both cases excluded repairs and renewals. Of course, the reduction of last year was due to the larger number of units sold, and not in consequence of dark weather, and it was in that direction they must look for future profits. The number of lamps connected on their circuits up to date was 365,560, and the applications 382,750; therefore there were a little over 17,000 lamps awaiting connection. As he had before said, he believed they had the most difficult district to light not only in London, but perhaps in any part of the world. It was only for a short time—perhaps three or four months in the year, and even at that period for but a short time—that the lamps in the City were alight in the day time, earning good money; and consequently, during a great part of the year the works were almost in a state of repose. The difficulty of meeting those conditions was very great from a technical point of view, and more so when they took financial considerations into account. It was common sense that their machinery must be capable of supplying the maximum load, and consequently about 12,000 or 13,000 horse-power was lying idle the greater part of the year, due to the fluctuating character of the consumption of the light. They had yet a very large reserve, which would enable them to connect a great many more lamps to their system. The net return per unit for 1897 was 7·10d. when the maximum charge was 8d.; last year it was 6·2d., when the maximum charge was 7d. The board were fully alive to a progressive policy, and had put in hand work by which almost immediately they would be able to give to the citizens direct current for motive power, or for any other purposes they might think fit, and they had also inaugurated a wiring scheme by which customers could have their premises wired by paying a moderate rental to the company. The generation and distribution expenses, including repairs and renewals, were in 1897 31·3 per cent., and last year that figure rose to 36·1 per cent., and it might appear that they were going backwards. But that was really not the case, for it was purely a percentage, and must increase as the receipts went back. As to the issue of fresh capital to continue the work, it was not the intention of the board to issue any more capital until the last moment, in order that there should not be more charge against the revenue for interest than was absolutely necessary. The most absurd rumours had appeared in various quarters, which he could hardly imagine that anyone who knew the history of the company believed for one moment. He referred more particularly to the statement that the capital had been watered. All such statements were absolutely untrue, and he would give them the figures to show how they really stood. It was perfectly true that the pioneer company, which enabled the City to have the light many years earlier than otherwise would have been the case, received as the price of their surrender was £25,000, and the other money they received was actually for work done. The present capital of their company was £1,400,000, and all the preliminary expenses and the expenses of subsequent issues amounting to £46,686, against which the company received premiums to the extent of £221,924 upon which no dividend or interest was payable, and consequently instead of the company having been watered it actually possessed a net sum of £175,338 against which no dividend ranked. He thought under all the circumstances the shareholders had no reason to be dissatisfied at what had been done. The directors intended to oppose the threat to invade their district by neighbouring companies. They looked upon such an attempt not only in an unfriendly light, but a

a very unfair step for any company to take. It was an attempt to rob them not only of a part but of the whole of the property which they had built up by hard work and heavy expenditure. The directors had already laid their case before the Board of Trade, and he thought they had made out a very strong case against any competing company coming into their area. It appeared inconceivable that the Board of Trade, which had dealt so fairly in assigning the various districts of London to different companies in the past, would now depart from the attitude they had adopted on previous occasions. He believed that they would, without hesitation, refuse the demands which those outside companies were making to invade their area. As to the relations between the Corporation, they had made contracts with the company, and to reasonable men it was only natural that when two parties agreed to a contract that they would both do their utmost loyally to carry it out and work together harmoniously. Unfortunately, the members of the Corporation were a changing body, and there were some now who did regard with favour the contracts which their predecessors entered into. They were too apt to judge by what they saw at the present time, instead of going back to see how matters stood at the time the contracts were entered into. From a purely business point of view, however, even those persons should uphold that company, for the stronger they made its position the better for the City. If the City had no desire to purchase the undertaking, it was plain that a successful company could serve the citizens better than an unsuccessful concern; and if, on the other hand, the City authorities desired to purchase the company, then it was common sense that it would be far cheaper for them to buy a successful undertaking than one that was sick. The company had been far more liberal to the citizens than was anticipated when the agreements were drawn up, and the continual increase in the number of their customers was perhaps the strongest proof that they had worked honestly, both in the interest of the consumer and the shareholder.

Col. Martindale seconded the motion, and said he entertained the greatest confidence in the future of the company.

Mr. H. Young asked whether it was a fact that owing to the non-delivery of certain machinery, the company had been unable to keep up the correct pressure in the mains, and whether, as a result of that, some of the meters had registered too fast and others too slow, thus causing a serious loss to the company.

Mr. Prevost complained that £8 premium should have been charged on the shares last issued, and said he thought that any further issue should be issued at par to the existing shareholders.

Mr. Braithwaite said he would like to know, presuming the competing companies got into their area, whether that would relieve them of the onerous contract which they at present had with the Corporation. They had spent £119,000 of capital on public lighting, and the profit was only £662, or less than a half per cent., so that the City had practically got its public lighting for nothing.

The Chairman, in reply, said it was perfectly true that for a day or two they had a low pressure of current due to the non-delivery of some machinery and coal, and which possibly produced them some loss. Regarding the price at which the additional shares would be issued, he would not like to bind the board in the matter. It might be advantageous to issue them at par or at a high premium. With regard to Mr. Braithwaite's question, the solicitor advised them it was not advisable to enter into that matter there.

The report was then adopted.

The Metropolitan Electric Supply Company, Limited.

The report of directors to be held on March 14th states that the capital expenditure, which at the end of 1897 amounted to £850,831 10s. 9d., has now reached a total of £993,761 13s. 9d., being an increase during the year of £142,930 3s. The principal items are mains and plant, and the expenditure on the new works at Willesden. The balance of capital in hand at the end of the year was £5,197 15s. 10d. The gross revenue for the year amounted to £151,605 12s. 3d., against £138,267 14s. 6d. in 1897, being an increase of £13,337 17s. 9d., to which reference is made in the next paragraph. The cost of generation, which in 1897 was £58,604 5s. 4d., amounted in 1898 to £76,736 8s. 7d., or an increase of £18,132 3s. 3d. Although the sales of current during the past year increased, the profits have not been in proportion. This is principally accounted for by necessary considerable reductions in rates of charge, by the coal strike in South Wales, and by the fire at the Manchester Square Works, which for a time incapacitated this important station. During the year, as the shareholders are aware, negotiations were carried on with the holders of founders' shares which resulted in the rights attaching to these shares being extinguished on the terms submitted to and approved by the shareholders. The Bill authorising the company to erect generating works at Willesden and to supply current therefrom, to which sanction was given by the shareholders on March 7th, 1898, was duly passed by Parliament during the year. The Bill promoted by the Marylebone Vestry to enable them to obtain competitive powers of supply to this company was successfully opposed. The balance to the credit of the revenue account, before providing for depreciation, is £53,563 14s. 3d. The directors have set aside £13,000 as an addition to the depreciation and reserve fund, carrying to the credit of the net revenue account (No. 5) the sum of £40,563 14s. 3d., which, with the balance brought forward from last account and other receipts, makes a total of £44,473 18s. After deducting debenture and share interest and other charges, there appears a balance of £17,872 6s. 4d. An interim dividend of 5s. per share on the ordinary share capital was paid on September 23rd, 1898, amounting to £15,625, and the directors recommend that a further dividend of 5s. per share on such shares be now paid, making a total distribution of 10s. per share for the year, or 5 per cent. on the capital. The dividend upon the new shares will be at the same rate per cent. calculated from the due dates of the instalments. This will absorb a further sum of £16,420 4s. 3d., and leave a balance of £1,452 2s. 1d. to be carried forward to the next account. The number of 8-candle-power lamps supplied by the company increased during the year 1898 from 360,000 to 430,000. The present number of lamps connected is 440,000, and the applications show no sign of decrease.

The House-to-House Electric Light Supply Company, Limited.

In submitting to the shareholders the balance sheet and accounts for the year ended December 31st, 1898, the directors report that the revenue account shows a credit balance of £14,066 3s., which, with the balance of £226 5s. 10d. brought forward, and £742 15s. 7d. balance of interest received, makes a total of £15,035 4s. 5d. After deducting £2,250 for interest on debenture stock paid and accrued, £1,767 10s. for interim dividend paid on the 7 per cent. cumulative preference shares, and £1,982 12s. 6d. for interim dividend at the rate of 5 per cent. per annum for the half-year to June 30th, 1898, on the ordinary shares, the directors recommend that the sum remaining, viz, £9,035 1s. 11d., be dealt with as follows:—

To credit of depreciation account	£4,000	0	0
To payment of the remainder of dividend to December 31st, 1898, on the 7 per cent. cumulative preference shares	2,100	0	0
To payment of a dividend on the ordinary shares for the half-year to December 31st, 1898, at 7 per cent. per annum, making 6 per cent. for the year	2,775	13	6
And that the balance of... ... ... be carried forward to the next account.	159	8	5
Total ...	£9,035	1	11

The following table shows the progress of the company's electric lighting business since 1890:—

Year.	Equivalent of 35 watt (8.C.P.) lamps connected.	Increase in 35 watt (8-C.P.) lamps.	No. of customers connected.	Gross receipts.	Expenditure.	Net receipts.
				£ s. d.	£ s. d.	£ s. d.
1890	13,665	9,145	248	5,010 9 2	4,624 6 5	386 2 9
1891	19,888	5,723	373	8,328 3 11	6,077 14 10	2,250 9 1
1892	23,700	4,812	471	10,688 18 6	7,851 19 6	2,836 19 0
1893	28,429	4,729	599	12,063 10 10	7,832 6 8	4,231 4 2
1894	35,858	7,429	755	13,695 11 8	7,431 16 8	6,263 15 0
1895	44.162	8,304	932	15,394 16 11	8,554 0 10	6 840 16 1
1896	55,265	11,103	1,164	17,442 6 5	8,410 8 4	9,031 18 1
1897	66.364	11,099	1,416	20,810 10 1	8,777 5 2	12,033 4 11
1898	80,301	13,937	1,777	24,906 17 11	10,840 14 11	14,066 3 0

Additions and alterations to the plant and mains have been made at a cost of £19,423 8s. 2d. As stated in the last report, certain of the plant having been superseded, has been sold at a loss. The directors consider that the proportion of this loss chargeable to the current year has been adequately provided for by the increased sum placed to the credit of depreciation account. Mr. W. R. Davies and Mr. W. F. Leese retire from the board by rotation, and, being eligible, offer themselves for re-election. Messrs. Miall, Wilkins, Randal & Co., the auditors of the company, offer themselves for re-election.

The meeting was held yesterday at Winchester House, E.C.

The British Insulated Wire Company, Limited.

The report of the directors for the year ended December 31st, 1898, to be submitted to the shareholders at the third ordinary general meeting, to be held at the offices of the company, Prescot, Lancashire, on Wednesday, March 15th, 1899, at 2 o'clock in the afternoon, states that the gross profits for the year amount to £72,185 1s. 6d., from which has to be deducted administration, legal expenses, fees on patents, and interest on debentures, amounting to £17,475 1s. 7d., leaving a balance of £54,709 19s. 11d. This amount has been charged with depreciation of buildings, plant and machinery, according to scale, £5,958 5s. 8d; amount written off goodwill and patents, £9,344 6s. 11d., and balance of preliminary and reconstruction expenses, £3,600 19s. 6d., a total of £19,103 12s. 1d., leaving a balance to be dealt with of £35,606 7s. 10d. The following dividends have already been paid, viz, dividend on preference shares, £5,121 8s. 9d, and interim dividend on ordinary shares at the rate of 10 per cent. per annum, £8,999 19s. 6d., leaving a final balance of £21,484 19s. 7d. The directors recommend that a further dividend of 10 per cent. shall be paid to the ordinary shareholders, making 15 per cent. for the year, which will absorb £19,499 19s. 9d., carrying forward £1,984 19s. 10d. to next account. During the year 7,500 preference shares additional have been issued. The results of the year's working have been most satisfactory, and have fully justified the extension of the works and the introduction of additional capital. Though a much larger quantity of goods was sent out during the year, the amount of orders on hand at the end of 1898 is so greatly increased that a larger business may be anticipated for the current year. Mr. John E. Pearson and Mr. Thomas Snape, who are the retiring directors being eligible, offer themselves for re-election. Messrs. Chalmers Wade & Co., the auditors, also retire, and offer themselves for re-election.

London Electric Supply Corporation, Limited.

The ordinary general meeting of the shareholders of this company was held on Thursday, March 2nd, at the Cannon Street Hotel, under the presidency of Lord Wantage, V.C.

The Chairman, in moving the adoption of the report, said he wished first of all to congratulate the shareholders upon regaining possession of the undertaking, as a consequence of which the meetings of the corporation were again resumed. When he last had the pleasure of meeting them, he gave them an account of the business during 1897, and informed them of the result of the working up to March 31st, 1898. As the present meeting was only asked to adopt the accounts for the half-year ended December last, it might be interesting to them to know the results of the working for the half-year which ended last June—the date when the receivership expired. The profits for that half-year were £10,131, as compared with £6,113 for the corresponding half of 1897, a gain of £4,018, or about 66 per cent. As they knew, the receiver was appointed in July, 1894, prior to which the corporation was carrying on the business at a loss. The result of the first half-year's working ending December, 1894, under the receiver was a profit of £1,300. For the year 1895 the profit had increased to £6,600, in 1896 it was £7,600, for 1897 £16,586, and for the half-year ended June, 1898, the profits were £10,131. It would be observed that over the whole four years the profits showed a steady and satisfactory rate of progress. After deducting the interest on loans, those profits were applied to the reduction of the debt due by the corporation, so that at the present time instead of there being a debt of £170,795 to pay off, it had been reduced to £110 000. Passing to the present and turning to capital account, his Lordship said it would be seen that effect had been given to the resolution passed by the extraordinary general meeting held last June to reduce the ordinary shares of the corporation from £5 to £3, and by that means they had been able to write down works to the extent of £181,688, and in addition they had written off the whole of the preliminary expenses account and an old account called the debenture discount account. The effect of writing down those assets was to put their capital account on a much stronger basis, and the items set forth therein now fairly represented their value. In addition £5,565 had been written off certain other accounts for depreciation. The court readily granted their application for these reductions, and when they made their issue of £200,000 4 per cent. mortgage debenture stock, the whole issue was applied for twice over by their own shareholders. During the half-year they had spent £23,076 on capital account, nearly half of which £10,938 was on account of the new 2,000-H.P. plant supplied in October last and which had worked satisfactorily during the winter. They also spent £6,697 in extending their distributing mains in Bermondsey, Rotherhithe, and Greenwich. They had now 28 miles of trunk and 64 miles of distributing mains laid, and they must always be prepared to extend them as new business came along. There was an item of £285, which was almost entirely represented by the cost to which they were put in defending themselves against the endeavour of the Bermondsey Vestry to obtain Parliamentary powers to enable them to enter into competition with the corporation for the supply of electric light in the parish. Although the Vestry were not successful last session, they had given notice that they would renew their attack in the present session. It was unjust that electric lighting companies, who had originally obtained their order with the consent of the local authority, which had the power of purchasing the undertaking on favourable terms at the end of 42 years, should be subject to attacks of that kind. Local authorities declined to take the risk of putting down stations for the supply of electric light when they had the opportunity, but they left private companies to take the risk. Now some of those local authorities—Bermondsey being one—were seeking to enter into competition with the companies, immediately there were signs that the profit-earning stage had been reached. They ignored the years of effort that had been made to reach that stage and the large amount of capital that had been expended on which the shareholders had received no dividends. He did not call it competition, but confiscation, under such circumstances. He believed the public were alive to the fact that it was confiscation, and he hoped Parliament would be equally alive to it. He certainly did not believe it was ever the intention of Parliament, when the order was granted, that such competition should be allowed. The duration of the order was only for 42 years, and at the expiry of that period the local authorities might purchase the undertakings on terms extremely favourable to themselves. Those local authorities who were now seeking competitive powers sought to oust the companies, and thus evade the guarantee given by Parliament of a 42 years' tenure, and would try and take away the business of the supply companies without purchasing the undertakings as it was intended they should do. The other item in the capital account was £36,728, which was the balance that remained, and which he believed would be sufficient for their requirements during the year. They had increased their lamp connections last year by 31,221 lights—an increase equal to 25 per cent., and while they were not sanguine that that rate of increase would be maintained, it was satisfactory to know that so far as the present year had gone, the new business showed no signs of falling off. During the current year they had made arrangements for the supply of certain new plant and machinery. They were gradually eliminating the old Ferranti trunk mains by new trunk mains, and using the old ones as distributing mains. The gross revenue for the half-year was £37,226 against £27,903 in the corresponding half of the previous year. The profit on the working had amounted to £13,535, being an increase of £3,064 over the corresponding six months. That increase would have been greater had it not been for the Welsh coal strike, which put them to a large additional expense; but, notwithstanding that increase, they had been able to reduce the cost per unit. They had to compete with gas, but, notwithstanding, they had nearly doubled the number of their customers during the past year. They had received an average price of 4½d. per unit against 8d. per unit, which they were authorised to charge. That reduction had resulted in a large increase of customers in the poor parishes on the south side of the Thames, and as it had brought in increased profits, the reduction was fully justified. The board had relinquished half of their fees, and would continue to do so until such time as a dividend was paid on the ordinary shares.

Mr. Roger Quincey seconded the motion, which, after a short discussion, was carried.

New Issue.

The City and South London Railway Company are making an issue of fresh capital for the completion of their railway to the "Angel" at Islington, the construction of which was authorised six years ago. This is an important step in the history of the company. This, the pioneer of underground electric railways, has up to the present time been an isolated line of three miles in length, connecting the southern suburbs of Kennington and Stockwell with the City. But by the extensions which are to be opened for traffic in a few months it will become a line through the heart of the City, having connections with all the principal existing railways engaged in Metropolitan traffic in the centre and south of London, and by the further extension now to be made it will bring in the traffic from the North as well as from the South, and form a connection between the two which has so long been wanted. When it reaches the "Angel" it will be within half a mile of the Midland Railway, and there is little doubt that a connection with that line will be made before long, and afford another access for the vast growing traffic of that system, the necessity for providing for which was so urgently dwelt upon by Sir Ernest Paget at the half-yearly meeting a few days ago. The present issue is of £375,000 in £10 ordinary shares. Interest at 3 per cent. will be paid on the amount paid up until the opening of the extension. The list closes on Tuesday next, 14th inst.

Bournemouth and District Electric Supply Company, Limited.—The report for the year 1898 shows a balance to credit of the net revenue account, after payment of interest charges, commission, and reserve for depreciation, of £1,500, as against a loss of £92 for the previous year. Out of this sum the directors recommend a dividend on the ordinary shares at the rate of 5 per cent. for the year, less tax, leaving £117 to be carried forward.

The Nernst Electric Light Company.—We understand that the flotation of the company was not a conspicuous success, the underwriters being compelled to take up a large number of shares.

Windsor Electric Lighting and Installation Company.—The third annual general meeting was held on 1st inst., when the report and balance-sheet and a 6 per cent. dividend were approved.

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending March 4th, 1899, were £196 13s. 10d.; aggregate to date, £1,463 18s. 11d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending March 3rd, 1899, were £2,408 15s. 10d.; corresponding period, 1898, £2,322 7s. 9d.; increase, £176 8s. 1d.

The City and South London Railway Company.—The receipts for the week ending March 5th, 1899, were £1,111; week ending March 6th, 1898, £1,089; increase, £22; total receipts for half-year, 1899, £11,108; corresponding period, 1898, £10,720; increase, £388. Miles open, 3½.

The Dover Corporation Electric Tramways.—The receipts for the week ending March 4th, 1899, were £189 18s. 8d.; week ending March 5th, 1898, £99 15s.; increase, £89 18s. 8d. Total receipts to date, 1899, £1,282 16s. 8d.; corresponding period, 1898, £948 5s. 9d.; increase, £334 10s. 11d. Miles of track open week ending March 4th, 1899, 3; week ending March 5th, 1898, 3. Car miles run week ending March 4th, 1899, 4,261; week ending March 5th, 1898, 2,819. Number of cars, week ending March 4th, 1899, 11; week ending March 5th, 1898, 7.

The Dublin United Tramways Company.—The receipts for the week ending Friday, March 3rd, 1899, were as follows:—D. U. T. Co., horse cars, £1,641 15s. 2d.; ditto, electric cars, £951 9s. 6d.; D. S. D. Co., electric cars, £659 3s. 5d.; total, £3,252 8s. 1d.; corresponding week last year—D. U. T. Co., horse cars, £2 412 17s. 3d.; ditto, electric cars, £118 0s. 1d.; D. S. D. Co., electric cars, £375 3s.; total, £2,896 0s. 4d.; increase, £356 7s. 9d.; aggregate to date, £28,535 7s. 9d.; ditto last year, £27,364 10s. 3d.; increase to date, £1,170 17s. 6d. Worked:—The mileage open is 18 miles electrically, 26 miles by horses, as against 11 miles electrically, and 31 miles by horses, for the corresponding period last year.

The Halifax Corporation Tramways. —The receipts for the week ending March 1st, 1899, were £202; total receipts to date, 1899, from June 30th, 1898, £9,428. Miles of track open, 3½. Car miles run, 5,353. Number of cars, 10.

The Liverpool Overhead Railway Company.—The receipts for the week ending March 5th, 1899, amounted to £1,288; corresponding week last year, £1,364; decrease, £79.

The South Staffordshire Tramways Company.—The receipts for week ending March 3rd, 1899, were £631 4s. 8d.; aggregate receipts for nine weeks, £5,845 16s. 4d.; week ending March 4th, 1898, £559 11s. 5d.; aggregate receipts for nine weeks, £5,265 11s. 11d.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation, March 1st.	Closing Quotation, March 8th.	Business done during week ended March 8th, 1899. Highest.	Lowest.
124,400£	African Direct Telegraph, 4 % Debs.	100	...	...	...	100 —104	100 —104	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	3 — 4	3 — 4	...	...
125,000	Do. do. 5 % Debs. Red.	100	...	...	...	87 — 92	87 — 92	...	...
905,560£	Anglo-American Telegraph	Stock	£2 13s	3 %	£3 9s	67 — 69	65 — 68	68	66½
3,047,220£	Do. do. 6 % Pref.	Stock	£5 6s	6 %	6 %	119 — 120	117½—118½	119⅜	118½
3,047,220£	Do. do. Deferred...	Stock	...	...	18s. %	14¼— 15	14¼— 14⅝	14⅝	14⅜
130,000	Brazilian Submarine Telegraph	10	7 %	7 %	...	16 — 16½	16 — 16½	16⅝	16½
75,000£	Do. do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	110 —114	110 —114	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	...	2⅜— 3½	2⅜— 3½	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	...	190 —200	190 —200	...	...
1,332,523£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	105 —107	105 —107	106¼	105⅜
224,850	Consolidated Telephone Construction and Manufacturing	10/-	2 %	...	...	1/16— 3/16	1/16— 3/16	...	...
16,000	Cuba Telegraph	10	8 %	7 %	...	9½— 10½	9½— 10½	10½	9⅜
6,000	Do. 10 % Pref.	10	10 %	10 %	...	17½— 18½	17½— 18½	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	...	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	...	10 — 11	10 — 11	...	...
30,000£	Do. do. 4½ % Debs., Nos. 1 to 6,000 ...	50	4½ %	4½ %	...	104 —107%	104 —107%	...	...
60,710£	Direct United States Cable	20	2½ %	...	...	12¼— 12⅜	12¼— 12⅜	12 9/16	12 7/16
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	103 —106	103 —106	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	...	...	...	180 —185	180 —185	183	182
1,795,000	Do. 3½ % Pref. Stock	100	...	...	...	104 —107	104 —107	105⅜	...
89,900	Do. 5 % Debs., repayable August, 1899 ...	100	5 %	5 %	...	99 —102	99 —102	...	...
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	126 —130	126 —130	126¼	...
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	...	18 — 18½	18 — 18½	18¼	...
16,200£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	5 %	...	99 —103	99 —103	...	...
64,400£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	...	100 —103	100 —103	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	...	125 —129	125 —129	...	...
35,100£	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	...	...	99 —103	99 —103	...	...
46,500£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	...	...	100 —103	100 —103	...	...
300,000£	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	...	...	102 —105	102 —105	...	...
200,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	4 %	...	...	104 —107%	104 —107%	...	...
180,227	Globe Telegraph and Trust	10	4½ %	4½ %	...	12⅜— 13¼	12⅜— 13¼	13⅛	12⅞
180,042	Do. do. 6 % Pref.	10	6 %	6 %	...	17 — 17½	17 — 17½	17	...
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	10 %	...	30 — 31	30 — 31	...	...
150,000£	Do. do. do. do. 5 % Debs. ...	100	5 %	5 %	...	98 —102xd	... — ...	...	...
97,800	Halifax & Bermuda Cable, 4½% 1st. Mt. Dbs., w'n. 1-1,200, rd.	100	...	...	...	100 —103	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	...	58 — 61	57 — 60	...	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	6 %	...	107 —110 xd	108 —111	...	...
484,597	National Telephone, 1 to 484,597	5	5½ %	6 %	6 %	5⅜— 5⅝xd	4½— 5	5½	4⅜
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	14 — 16 xd	13 — 15	15	14⅜
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	14 — 16 xd	13 — 15	14⅜	13
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5½— 5½xd	4½— 5	5 7/16	4⅞
1,329,471£	Do. 3½ % Deb. Stock Red.	Stock	3½ %	3½ %	3½ %	100 —102	99 —101	101½	99½
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	...	⅝— ¾	⅝— ¾	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	4 %	...	105 —108	105 —108	...	...
11,839	Reuter's	8	5 %	5 %	...	6½— 7½	6½— 7½	7¼	6⅞
3,381	Submarine Cables Trust	Cert.	...	...	...	139 —144	139 —144	...	...
58,000	United River Plate Telephone	5	5 %	6 %	...	4⅜— 5¼	4⅜— 5¼	...	...
151,733£	Do. do. 5 % Debs.	Stock	...	...	...	104 —107	104 —107	...	...
200,000£	West African Telegraph, 5 % Debs.	100	5 %	5 %	...	97 —100 xd	98 —101	98⅝	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	½— 1	½— 1	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Braz. Sub. Tel.	100	...	...	...	103 —106	103 —106	...	...
889,521	Western and Brazilian Telegraph 4 % Deb. Stock Red. ...	Stock	...	...	...	107 —110	107 —110	...	...
88,321	West India and Panama Telegraph	10	1 %	⅝%	...	1⅞— 2⅛	1⅞— 2⅛	2 1/16	1 15/16
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	6 %	...	10½— 11	10½— 11	10⅝	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	6 %	...	9 — 10	9 — 10	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	...	105 —108	105 —108	...	...
158,100£	Western Union of U.S. Telegraph, 6 % Ster. Bonds ...	100	6 %	6 %	...	98 —103 xd	98 —103	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electricity Supply	5	6 %	7 %	8 %	11½— 12½	11½— 12½	12⅛	...
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	6 — 6½	6 — 6½	...	...
34,000	*Chelsea Electricity Supply, Ord., ...	5	5 %	6 %	6 %	8½— 9½	8½— 9½	9	...
60,000	Do. do. do. % Deb. Stock Red....	Stock	4½ %	4½ %	...	114 —116	114 —116	...	...
50,000	City of London Electric Lighting, Ord. 40,001—90,000 ...	10	7 %	10 %	6 %	19½— 20½	19½— 20½	20½	19½
10,000	Do. Ord. Nos. 90,001 to 100,000	10	...	...	...	19 — 20	19 — 20	...	...
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	15 — 16	15 — 16	...	...
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	...	124 —129	124 —129	125½	...
30,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—30,000	10	nil	nil	...	12½— 13½	12 — 13	12 1/16	12⅜
10,000	Do. do. do. Nos. 30,001 to 40,000 ...	10	...	...	...	12½— 13½	12 — 13	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	...	14½— 15½	14½— 15½	15⅛	14 15/16
17,400	Edmundsons Elec. Corp., Ord. Shares 1—17,400	5	...	5 %	...	5¼— 5⅜	5¼— 5⅜	...	...
15,661	House-to-House Electric Light Supply, Ord., 101 to 15,761	5	...	4 %	6 %	9 — 10	9 — 10	...	...
12,000	Do. do. 7 % Cum. Pref. ...	5	7 %	7 %	...	9½— 10½	9½— 10½	10	9⅞
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	3½— 4	3½— 4	3 15/16	3⅝
48,050	Do. do. do. 6 % Pref.	5	...	...	6 %	6½— 7	6½— 7	6 13/16	6¾
100,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	104 —106	104 —106	...	...
62,500	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	5 %	16½— 17½	16½— 17½	17⅜	16¾
22,500	Do. Nos. 62,501 to 85,000, £7 paid ...	10	...	...	...	13½— 14½	12½— 13½	...	...
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	4½ %	4½ %	...	118 —121	118 —121	...	...
6,452	Notting Hill Electric Lighting	10	4 %	6 %	6 %	16½— 17½	16½— 17½	...	...
31,980	St. James's and Pall Mall Electric Light, Ord.	5	10½ %	14½ %	14½ %	16½— 17½	16½— 17½	17 1/16	16¾
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 10 xd	9 — 10	9⅜	...
65,000	South London Electricity Supply, Ord., £3 paid	5	...	...	...	3¼— 3½	3¼— 3½	3 7/16	3⅜
79,900	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	9 %	12 %	12 %	15½— 16½xd	15½— 16½	16	15 11/16

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.
‡ Unless otherwise stated all shares are fully paid. § Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked ‡ are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation Mar. 1st.	Closing Quotation Mar. 8th.	Business done during week ended Mar. 8 h, 1899. Highest.	Lowest.
60,000	Aluminium "A" shares, Nos. 1—60,000	1	...	...	...	3 — 3⅛	3 — 3⅛	...	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	94 —100	94 —100	99	98½
30,000	British Electric Traction	10	...	...	...	16⅛— 17⅛	17⅛— 18⅛	17⅜	17⅛
10,000	Do. do. 6 % Cum. Pref. 30,001—40,000 (issued at £2 10s. prem. all pd.)	10	...	...	...	13½— 13⅝	13¼— 13⅜	13⅜	13¼
100,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	125 —127	125 —127	...	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	*nil*	*nil*	...	2 — 2⅛	1⅞— 2⅛	2	1⅞
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	*nil*	4 %	...	2⅛— 2⅜xd	2⅛— 2⅜	2⅜	2¼
125,000*l*	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	110 —114 xd	110 —114	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	101 —104	101 —104	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	...	...	...	12½— 13½	12½— 13½	13	2 1/16
90,000	Do. do 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	114 —117	114 —117	...	...
35,250	Central London Railway, Ord. Shares	10	...	...	...	9⅝— 10¼	9⅝— 10¼	10⅛	10 1/16
178,303	Do. do. do. £8 paid	10	...	...	...	7¾— 8¼	7¾— 8¼	8	...
61,033	Do. do. Pref. half-shares £3 paid ...	...	...	...	...	3½— 4	3½— 4	...	...
71,447	Do. do. Def. do. £5 paid ...	...	...	...	...	4¼— 4⅝	4¼— 4⅝	...	...
630,000*l*	City and South London Railway	Stock	1 9/16 %	1⅞%	2⅛%	71 — 73	70 — 72	71	70½
22,500	Do. do. Ord. shares, Nos. 1 to 22,500 £5 pd.	10	...	...	...	4⅜— 5¼	4⅜— 5½	5	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	3¼— 3⅝	3¼— 3⅞	3⅝	...
82,850	Do. 5% 1st Mort. Reg. Debs., 1 to 743 of £100, and 901 to 1,070 of £50 Red.	...	...	...	...	98 —101	98 — 101	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5⅛%	6 %	...	2¼— 2⅜xd	2¼— 2⅜	2⅜	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	5⅛%	6 %	...	4 — 5 xd	4 — 5	...	...
194,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	98 —100	98 —100	98¼	...
112,100	Electric Construction, 1 to 112,100	2	5 %	6 %	6 %	2¼— 2½	2¼— 2½	2 7/16	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	7 %	3 — 3½	3 — 3½	3 5/16	...
140,300	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	103 —106	103 —106	105½	104
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	5/16— 7/16	5/16— 7/16	...	...
67,275	Elmore's Wire Manufacturing, 1 to 69,385, issued at 1 pm.	2	...	...	...	⅛— ¼	⅛— ¼	...	...
9,600*l*	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	7 %	...	10 — 12	10 — 12	...	...
12,500	Henley's (W. T.) Telegraph Works, Ord.	10	10 %	12 %	14 %	26½— 27½	27 — 28	27⅜	27¼
3,000	Do. do. do. 7 % Pref.	10	7 %	7 %	7 %	18½— 19½	18½— 19½	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½%	4½%	...	113 —116	113 —116	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	22 — 23 xd	22 — 23	22⅝	22¼
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	102 —106	102 —106	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	2⅞%	3¼%	3¼%	9 1/16—10 1/16 xd	10 — 10½	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	14½— 15 xd	14½— 15	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	40 — 44	40 — 44	40½	...
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	104 —107	104 —107	...	...
13,400	Telegraph Manufacturing, Ord. Nos. 6,601 to 20,000 ...	5	...	...	...	9¼— 9¾	9¼— 9¾	9¾	9⅝
13,400	Do. do. 5% Cm. Prf. Nos. 6,601 to 20,000	5	...	...	...	5¾— 6¼	5¾— 6¼	...	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	...	...	3 %	109 —112	109 —112	110½	...

† Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid.

Dividends marked ‡ are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 10¼.
British Aluminium, Ordinary, 10½—11½; 7 % Pref., 12—13.
House-to-House, 4½% Debentures of £100, 105—108.
Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 13—13½; 1st Preference Cumulative 6%, £5 (fully paid), 7½—8. Debentures, 107—110. Dividend, 1898, on Ordinary Shares 10%.
National Electric Free Wiring, 10s. paid, 8/- to 10/-.
Smithfield Market Electric, 4—4½.
*T. Parker, £10 (fully paid), 15¾.

* From Birmingham Share List.

Bank rate of discount 3 per cent. (February 2nd, 1899).

MARKET QUOTATIONS, Wednesday, March 8th.

CHEMICALS, &c.		This week.	Last week.	Increase or Decrease.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a „ Nitric	per cwt.	22/-	22/-	..
a „ Oxalic	per cwt.	33/-	33/-	..
a „ Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	37/-	37/-	..
a Ammonia, Muriate (grey) ..	per ton	£19	£19	..
a „ „ (white) ..	per ton	£26	£26	..
a Bleaching powder	per ton	£5 15	£5 15	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£16 10	£16 10	..
a Benzole (90 %)	per gal.	7/-	7/-	..
a „ (50,90 %)	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£26	£26	..
a Lead, Nitrate	per ton	£23 10	£23 10	..
a „ White Sugar	per ton	£30 10	£30 10	..
a „ Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 160° C.)	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks..	per lb.	8¾d.	8¾d.	..
a „ Caustic (75,80 %) ..	per ton	£24	£24	..
a „ Bisulphate	per ton	£35	£35	..
a Shellac	per cwt.	67/-	67/-	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6 15	£6 15	..
a „ Recovered	per ton	£5 15	£5 15	..
a „ Lump	per ton	£5 5	£5 5	..
a Soda, Caustic (white 70 %) ..	per ton	£7 10	£7 10	..
a „ Crystals	per ton	£3	£3	..
a „ Bichromate, casks ..	per lb.	3d.	3d.	..
METALS, &c.				
b Aluminium Wire, in ton lots ..	per ton	£224	£224	..
b „ Sheet, in ton lots.. ..	per ton	£191	£191	..
p Babbitt's metal ingots	per ton	£65 to £130	..	..
c Brass (rolled metal 2" to 12") basis	per lb.	8¼d.	8¼d.	..
c „ Tube (brazed)	per lb.	10d.	10d.	..
c „ Wire, basis	per lb.	8¼d.	8¼d.	..

METALS, &c. (*continued*).		This week.	Last week.	Increase or Decrease.
f Ebonite Rod	per lb.	3/-	3/-	..
f „ Sheet	per lb.	5/-	5/-	..
g Copper Bars	per ton	£79	£79	..
g „ Wire (basis price) ..	per lb.	9¾d.	9¾d.	..
g „ Sheet	per ton	£79	£79	..
g „ Rod	per ton	£79	£79	..
n German Silver Wire	per lb.	1/6	1/6	..
h Gutta-percha, fine	per lb.	6/-	6/-	..
h India-rubber, Para fine ..	per lb.	4/4½	4/2½	2d. inc.
i Iron, Charcoal Sheets	per ton	£18	£18	..
i „ Pig (Cleveland warrants)	per ton	47/7½	47/7½	..
i „ Forgings, according to size	per ton	From £11	From £11	..
i „ Scrap, heavy	per ton	50/- to 55/-	50/- to 55/-	..
i „ Wire galvanised No. 8 ..	per ton	£9 5	£9 5	..
g Lead, English Ingot	per ton	£15	£15	..
g „ „ Sheet	per ton	£15	£15	..
l Mica (uncut slabs 8" long) ..	per lb.	6/6	6/6	..
m Manganin Wire No. 28.. ..	per lb.	8/-	8/-	..
g Mercury	per bottle	£8 5	£8 5	..
p Phosphor Bronze, plain castings	per lb.	1/- to 1/4	..	..
p „ rolled bars & rods	per lb.	1/- to 1/4	..	..
p „ r'l'd strip & sheet	per lb.	From 1/2	..	..
o Platinum	per oz.	£3 6 6	£3 6 6	..
p Silicium Bronze Wire	per lb.	10d. to 1/1	..	..
i Steel, Magnet, acc'd'g to desc'p'n	p. ton	From £15	to £40	..
i Steel, Magnet, in bars		£58	£58	..
g Tin, block	per ton	£115	£115	..
g „ foil	per lb.	1/6	1/6	..
n „ wire Nos. 1 to 16	per lb.	1/6	1/6	..
p White Anti-friction Metals—				
"White Ant" brand ..	per ton	£40 to £65	£40 to £65	..
j Yarns, Cotton, Single 10lb. bundles	pr lb.	7½d.	7½d.	..
j „ Flax, 6 or 8 lea... ..	per lb.	4d.	4d.	..
j „ Hemp, 3 ply 10 lbs. ..	per lb.	3½d.	3½d.	..
j „ „ Russian, 10 lbs.	per lb.	4½d.	4½d.	..
j „ Jute, 180 lbs. rove ..	per ton	£12	£12	..
j „ Manila, 24 thread ..	per ton	£33 10	£33 10	..
k Zinc, Sheet (Vielle Montagne bnd.)	p.t.	£31	£31	..

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd.
c Messrs. Thos. Bolton & Sons.
d
e

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakspeare.
h Messrs. Jackson & Till.
i Messrs. Bolling & Lowe.
j Messrs. Henry C. Yeo & Co.

Quotations supplied by
k Messrs. Morris Ashby, Limited.
l Messrs. Sanders, Wake & Co.
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. P. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

SYSTEMS OF STOKING.

At a time when smoke prosecutions are so very rife, any suggestion, in reason, is welcome which points a way to smoke prevention. One way to burn coal smokelessly is to charge often small quantities upon a thin fire with a good draught. In this system a large volume of air in excess of actual chemical requirements is admitted through the grate, and the temperature of the products of combustion is much reduced, and evaporative efficiency is small. But the commercial use of coal demands economy. It is almost, if not quite, a crime to burn up a nation's store of coal without securing its fullest possible effects, and smoke prevention must not be secured at too heavy a cost. But cannot smoke be prevented in properly designed furnaces with economy. The *Practical Engineer* says that it can, and the article dealing with the question has evidently been written by an engineer of experience in the system he advocates, and who explained his system to us many years ago. In the first place he admits that a stoker, if allowed to have his own way, could maintain an absolutely smokeless chimney, but he is tied down by the necessity of maintaining steam, and it becomes necessary to force the fires. This, and insufficient air, are the causes of smoke, and with a forced fire the products of distillation are not mixed with oxygen at a sufficiently high temperature for combustion to be fully effected, and after being once cooled below ignition point, any further air admission is useless. What is known as ample boiler power is necessary to secure good results.

These considerations apply, of course, to bituminous fuels. Smokeless fuels only require sufficient draught to be burned at any rate of combustion, but such fuels give off products quite as deleterious as regards health and vegetation as anything produced by bituminous coal. It is the black soot to which people make objection, but it is a curious fact, and worth comment, that the homes of the decent working class population of the smoky towns of the north of England and other manufacturing districts are cleaner and brighter than is the case with the homes of people favoured by cleaner atmospheric conditions. It is laid down as a *sine qua non* that there must be sufficient boilers to allow the fires to be worked on the thick system of firing by heavy charges, and regulating by dampers. With this system we are assured there will be no need for any special apparatus. The writer says that he has seen a battery of boilers, the furnaces of which were charged heavily a few times a day only. There was a good chimney, and the fires were charged up to within a few inches of the furnace crowns (Lancashire boilers), and the dampers partially closed. As the steam pressure fell, a slight raising of the dampers was sufficient to send the pointers of the pressure gauges steadily upwards, and the stokers could sit two or three hours or more without throwing on fresh fuel. In this system the bars are kept well covered, and if any tendency was observed to burn through, the fuel would be pushed into the hollow places, and any inrush of cold air checked.

One steam user, who used the system on two boilers, stated that whenever he changed his stokers it was found that 2½ or 3 tons of coal per week would at first be added to the consumption, pending the acquisition of experience. This would be out of a total of about 24 tons per week for the two boilers.

Some years ago Mr. Longridge issued a report of certain tests he had made on thick and thin fires, and he had found that where thin fires had been employed on a long grate, and a change had been made by shortening the grate, thickening the fire, and regulating by damper much as above described, the economy was greatly increased, and the excess of air per pound of fuel was reduced very much, the total air consumption being only about 14 lbs. per pound of fuel.

The question resolves itself largely into one of boiler power. Let us suppose that a boiler with ordinary grates can do its work in the ordinary system with a combustion rate of 20 lbs. per square foot of grate per hour. If on some new system smokeless combustion can be secured with a rate of combustion of only 10 lbs., it follows that the boiler, even with its improved efficiency, can now only produce a little over half the power it was producing at the original rate of combustion. Two boilers are in fact now required. But it cannot be maintained that, if as originally arranged, the boiler would do its work with a weekly consumption of, say, 20 tons, two boilers are now required to burn only 18 tons, 2 tons being saved by the more efficient combustion. Double the grate area may reasonably be asked for, but surely not double the heating surface to deal with the reduced volume of gaseous products now issuing from the furnaces. The, at first, most obvious means of effecting the change is to make the boilers double-enders, with four in place of two furnaces. But Lancashire boilers so made are notoriously dangerous because of the very serious cutting away of the shell plates through which the flues must now pass. Obviously the necessity is for more grate surface in the same size of boiler and a less unit rate of combustion.

Probably some such unconscious reasoning as this leads up to the double-ender marine boiler, the products of combustion being got out of the boiler by means of the return small tubes and with more or less structural safety. The practical prohibition of external firing seems to bar the way to the simplest methods. But given the means for doing all this, is it not probable that the old smoke difficulty would again arise, and the grate surface provided for a 10 or 15 lbs. rate would be compelled to burn 20 to 30 lbs., and the result of the change would, after all, be merely to alter the time-honoured ratio of grate to heating surface, and to raise the demand for economiser pipes to reduce the greater excess of temperature. For existing plants we would say, set apart a boiler and supply it with weighed coal and metered water, and, after determining its output, change its system of stoking, and, as the man becomes experienced in the novel method note the effect, and calculate the total difference on the whole plant similarly treated. In this way some idea would be gained as to the possibilities of the method, and it would be known just how far short the plant really was from being a possible non-producer of smoke.

It does not, perhaps, follow absolutely that the use of such thick fires, as are recommended in the article referred to above, demands a reduced rate of combustion per square foot. In what we have said above, we have assumed the conditions of chimney-produced draught. But a chimney-produced draught is not a fixed thing, although commonly spoken of as such under the title of natural draught. It is exceedingly variable and never very great. But when the thickness of a fire is increased, the proper course to follow would appear to be to simultaneously increase the draught in order to have the power of putting as much air as necessary for the desired rate of combustion through the now magnified resistance of the thick fire. Thin fires are the product of poor chimney draught. One is a natural concomitant of the other. The locomotive exhibits the proper relation of fuel thickness to draught intensity. In the locomotive there is a deep fire box and a very thick fire which, by good stokers, is built up as thick as possible at the sides, so that the tendency to burn hollow at the thinnest part—the middle—is counteracted by the shaking down of the fuel from the sides. Fresh coal is fed on next to the water cooled plates; this lengthens the period during which the gases are driven off the fresh charges, and to some extent approximates a coking effect. The steam blast in the chimney produces draught enough to pull sufficient air through the grate and fuel bed, and the brick arch provides the form of furnace necessary to ensure smokeless combustion, and yet the rate of combustion per square foot of grate will be 60 to 100 lbs. per hour.

This points to the possibility of burning coal in stationary boilers at rates much in excess of chimney draught rates simply by the use of thick fires and powerful draught. One great advantage of the thick fire is the large mass of fuel ready at a moment's notice to be brought into active combustion by simple acceleration of the draught fan. But no amount of boiler room will, with or without fan draught, enable bituminous coal to be burned without smoke unless the conditions as to the form of the furnace and the course of the gases and air, and the after space in which the gases may complete their combustion, are correctly provided. It is much to be feared that the power to purchase smokeless fuel has been the cause of much of the neglect to provide such conditions, and the results are seen in the impossibility of at once altering plant to suit bituminous fuel when the supply of smokeless fuel falls off. Further, in regard to boiler power, we think that there has sprung up during the last few years a tendency among boiler makers to promise greater weights of evaporation than can, in practice, be carried into effect.

This is one of the mischievous tendencies of competition. No matter by what name a steam boiler may be introduced to the world, it will prove very much to resemble other steam boilers in its evaporation, and if one boiler will burn a ton of coal in a given time, so will another boiler of equal grate surface. These are figures which engineers should themselves care for rather than rely upon the promises of contractors. Otherwise it will by no means be the best, safest, or most honest contractor who will be secured. Eagerness to secure orders will sometimes tend to extract promises of output that can, perhaps, be attained at a formal high pressure trial, but which must by no means be expected to be secured in the rough and tumble of the daily struggle.

A margin of at least 25 per cent. upon such trial runs should be allowed in good conservative practice. While space should not be wastefully used in expensive localities, it is quite possible to economise too much. With machinery packed on the sardine principle, the extra cost which will result may easily balance the saving.

THE OKES-SERVE WATER-TUBE BOILER.

In this, a new form of water-tube boiler, the principle of the Field tube has been adopted as in the Niclausse French boiler, an internal tube leading the water to the lower ends of the main or external tubes, the return being *vid* the annular space between the two tubes. The upper ends of the two sets of tubes are fixed in separate plates, and communicate with entirely separate chambers. The rising box is connected at its upper end with the steam, and also with the water space of the upper transverse drum, while the bottom of the drum communicates, by means of two large down comer pipes, with the bottom of the other box. In this way the lowest set of tubes is the most assured of a full supply of water, a good feature, for any burning-out trouble is usually experienced with the lower tubes.

The supply box is really a closed chamber, having openings only to the field tubes, as we may term them, and to the water space of the steam drum. If the valves of the down comer pipes be closed, the opening of a blow-out at the bottom of the chamber will reverse the circulation in the boiler. This is a provision of some value, but we cannot say we like the valves on the down comers. It might happen—all kinds of improper and unexpected contingencies do happen with steam boilers—that some day the down comer valves were closed and left so, and the result would be the rapid overheating and burning out of possibly every tube in the boiler. From an illustration of this boiler in the *Engineer*, we are glad to see that the headers are made of plate, not of castings; but we think that the above dangerous valve arrangement should be in some way modified, and we also think that, for marine purposes especially, the tubes have too low an inclination. We do not dispute the value of the double tube for circulation purposes, but it is obvious there will be no real inclination of the tubes when a ship lists through quite a small angle. The double tube system has the advantage of allowing absolutely free expansion of the tubes, one end being simply supported, but in no

way fixed in a longitudinal direction. As illustrated, too, the boiler is fitted only for non-bituminous fuels. In case of a burn out of any single tube, there is no suitable provision for remedying except by stopping the boiler, but in this respect it is no worse off than other water-tube boilers. Water tubes cannot be plugged after the manner of fire tubes.

This new water-tube boiler probably most closely resembles the Dürr boiler, which is of German origin. It has, like it, the single flat water chambers or headers, and has the division of the up and the down headers into separate vessels, but in the Dürr boiler both headers open at the top into the steam drum, and in this respect the Okes boiler is certainly improved.

ELECTRIC TRACTION IN PORTO RICO.

If the average Briton were asked what he thought of the above question he would probably not be above confessing, in the first place, that he didn't know exactly where Porto Rico was, except that it is one of the Philippine Islands, or somewhere near Cuba—anyway, it is one of those places that Uncle Sam has just lately gobbled up; and secondly, that he didn't believe there was any electric traction in Porto Rico. Mr. Antonio Mattei Lluveras, however, tries to show to the readers of the *Engineering Magazine* that there is plenty of scope for electric tramways or light railways in the island, which is wonderfully rich from an agricultural standpoint, and very much in need of development.

Possibly our American friends and cousins will have their hands so full of the mere management of their new possessions that they may feel inclined to let a little British capital into the commercial development of the lands now lost to Spain; and hence may come opportunities for home firms to seek business, though it would be something truly worth chronicling if English electrical goods succeeded in finding a market under the nose of such enterprise in this particular direction as the United States has shown for the last 10 or 20 years.

Dealing with the matter on its technical merits alone, however, it is very interesting to see how obstacles which in this country we should look on as difficult for the use of electric traction, are considered in the New World as of no great moment. For instance, our author speaks of a military road across the island as having no grade greater than 14 per cent. "which would be the maximum to be met with in the construction of a tramway."

There appear already to be a few steam railways of narrow gauge in the island; but to judge from the description of one about 22 miles long, running out from Ponce, these lines are about on a level with the Jaffa-Jerusalem Railway. Indeed, a good deal of the carrying is done by ox carts in competition with the railway, the freight rates being a little lower, and the speeds nearly equal!

The author proposes an electric line right round the island coupling up the various railroads, with branches radiating inland in order to give ready access to the plantations where they grow splendid coffee, ditto sugar, and tobacco, which goes to Cuba for the express purpose of being branded as Havana leaf and thereby incrementing in value probably fourfold.

The movement in favour of electric lines for such sparse traffic as can be found in agricultural districts, is evidently growing very rapidly across the Atlantic, but we fear it will be a long while before engineers and capitalists on this side will tear themselves away from the pursuit of 10 to 14 passengers per car mile on busy town and city streets, for the sake of developing country districts where the cost of electric power is almost prohibitive for trains every hour or so.

Our Light Railways Act, moreover, is not altogether the great success it was expected to be, but while Board of Trade rules and regulations are of the usual cast-iron order, it is, perhaps, the best we can hope for in this country to give developments in the way of agricultural lines—which isn't much.

ELECTRICAL EXHIBITION AT BRUSSELS, 1899.

An electrical exhibition at Brussels under the patronage of His Majesty the King of the Belgians and H.R.H. Prince Albert of Belgium, organised by the Society of Belgian electricians, the town of Brussels, and the Administration of Telegraphs, will be opened on June 1st, 1899, in the new Hotel des Téléphones, Rue de la Paille, Brussels.

Its speciality is to show the latest improvements of electricity "at home," and is divided into 14 classes, as follows:—

Class 1.—*Light.* Incandescent and arc lamps of all kinds for domestic lighting, fittings of all sorts, cables and wires, switches, resistances, commutators and systems of steel tubes and wood casings.

Class 2.—*Electrical Heating.* Radiators, apparatus for the kitchen table, toilet, &c.

Class 3.—*Motive Power.* For sewing machines, ventilators, electric lifts, &c.

Class 4.—*Batteries and Accumulators.* Primary batteries and accumulators for domestic use.

Class 5.—*Telephone and Telegraph.* Telephone and private telegraph apparatus, switchboards, &c.

Class 6.—*Safety Apparatus, Bells, &c.* Barometer, thermometers for indicating electrically the increase of temperature caused by fire, &c., indicators for showing electrically the level of water, electric bells, water, dust, and gas proof bells, keys and indicators, pushes, &c.

Class 7.—*Electric Clocks.* Electric clocks and pendulums, electric alarum and other electrical apparatus for clocks.

Class 8.—*Health.* Electric "Pasteurisateurs," electrical apparatus for the production of ozone, electrical disinfection of houses.

Class 9.—*Medical Electricity.* Electro-therapeutic and electro-medical apparatus.

Class 10.—*Various Apparatus.* Lightning guards, electric luminous letters, electric washing apparatus, processes for artifically increasing the age of wines and alcohol by means of electricity, lightning conductors.

Class 11.—*Music, &c.* Apparatus for transcribing music, chimes, electric metronomes, &c.

Class 12.—*Electric Locks.* Apparatus for opening and closing doors from a distance; safety electric bolts, electric catch and locks.

Class 13.—*Electric Jewellery and Toys.* Electric toys of all kinds, electric luminous jewellery, luminous drawing-room fountains, Geissler's tubes.

Class 14.—*Furniture.* Furniture and ornaments, objects of art, and any other articles for decorating the interior of houses, either produced or ornamented by means of electricity.

Dynamos or any electric generator, with the exception of primary and secondary batteries, are *not* to be exhibited.

The speciality of the Exhibition is to show everything connected with electricity in the house, and to point out its advantages and the numerous ways it can be put into general practical use in every household.

Current can be obtained from the Brussels central station, which is a three-wire system, and exhibitors can have a tension of either 110 or 220 volts.

The president of the Executive Council is Mr. J. Banneux, the engineer-in-chief and director of the Belgian States Telegraphs; the vice-president, Mr. J. Wybauw, engineer-in-chief and director of the Service d'Electrécité to the town of Brussels; the secretary, Mr. Ed. Lacomblé, electrical engineer to the town of Brussels; the treasurer, Mr. Alker, electrical engineer.

Many of the chief electrical engineers and manufacturers in Belgium have already decided to exhibit their specialities, including Mr. L. Gerard, the managing director of the Compagnie de Traction Electrique; Mr. Douglas Wells, M.I.E.E., member of the Council for Conferences and Exhibitions of La Société Belge des Ingenieurs et Industriels, who represents the house of W. T. Glover & Co., Ltd., of Salford, for cables and wires, the Edison & Swan United Electric Light Co., Ltd., the Simplex Steel Conduit Co., Ltd., and other English firms; Mr. Goffin, vice-president of La Chambre Syndicate des Electriciens; Mr. Charlier, electrical expert; Dr. Requette and many others.

We hear that the Simplex Company will exhibit their system of steel tubes, showing the advantages both in price, simplicity, and mechanical protection over wood casing; Mercier's Patents, Ltd., of Greengate, Manchester, will exhibit their bells and keys, which are absolutely water, dust, and gas proof, a good many of which have been recently taken by the State Railways of Belgium.

It is hoped that a good number of English firms will come forward and show their specialities. Full particulars, with rules, plans, &c., can be obtained on application to the executive committee of the "Exposition de l'Electrécité à la Maison," 8, Rue Melsens, Brussels. Attention is specially drawn to the fact that all applications must be made before March 20th, 1899, or they will be rejected.

THE GENERAL POWER DISTRIBUTING COMPANY'S BILL.

In the House of Commons on Friday last, on the order for the second reading of the General Power Distributing Company Bill, which came from the House of Lords,

Mr. Stuart-Wortley moved its rejection. He said he should not take such a course unless for very strong reasons, but the matters dealt with by the Bill were of such public notoriety and importance, that they should not be allowed to form the subject of an inquiry by a small committee, but should be discussed by those who had experience of legislation affecting great municipalities. The Bill would empower a company of private undertakers to establish, at a small place in Nottinghamshire, a large generating station for electric light and power. Apparently, they were going to do so at a place called Worksop, but they were under no obligation to do so, and they would be entitled to place their station anywhere else within a radius of 26 miles, and that would bring into the field of their operations municipalities of the magnitude of Ilkeston, Retford, Mansfield, Chesterfield, Doncaster, Lincoln, Rotherham, Nottingham and Sheffield. The last-named, which principally interested him, was fifth in population of the boroughs of England. He asked the House to reject the Bill, because it was against all Parliamentary precedent, was unnecessary in the interest of consumers or for the advantage of the manufacturing interest, and was against public policy for many weighty reasons. It might be said that the Bill had been passed by a Committee of the other House, but, without disrespect, he must

say that the tenderness for the integrity and independence of municipal privileges was not likely to receive such unlimited respect and jealous watchfulness in the Upper as it did in the Lower House. The Lords also had thought themselves bound by a finding of a Joint Committee, which he thought did not apply.

Mr. Pickersgill (who also had a notice on the paper for the rejection of the Bill), in seconding the motion, said the district affected far transcended the limits of any mere local area, and the Bill was one of the volley of electric supply schemes with which the House was bombarded during the present session. One of these measures—the County of London and Brush Provincial Electric Lighting Bill—affected the metropolis, and would, if passed, prove a retrograde step. Many of the large municipalities who would be affected by the measure had spent considerable sums of public money in providing an electric supply, and it was obvious that if the Bill passed, the House would not only be preventing the initiation of new schemes by local authorities, but would also substantially check the schemes already existing. His second objection was that, although it was only a private Bill, it proposed to supersede the general law with regard to compulsory powers of purchase.

Mr. Bromley-Davenport supported the second reading of the Bill, declaring that the mover of the motion for its rejection had given no reasons to justify his extraordinary and reactionary attitude. He supported the rights of private enterprise and of the public as against this combination of scattered bodies, many of them with no interest in the question, in favour of the sacred rights of municipal monopoly. He would undertake that whatever was necessary should be done to prohibit any power of supply in areas within the Bill, except with the consent of the corporations concerned.

Mr. Stuart-Wortley said that interpreting his hon. friend's undertaking in the large and liberal sense in which it was made, he did not think they would be any longer justified in continuing their opposition to the Bill. He asked leave to withdraw his amendment.

Mr. Galloway said that the position had been entirely changed by the offer of the right hon. gentleman, and therefore he moved the adjournment of the debate in order that the House might have an opportunity of considering the matter.

Mr. Yoxall seconded.

Mr. Bromley-Davenport said he should not, of course, resist the motion if the House thought it should be carried, but hoped, after the concession he had made, the second reading would be taken.

Sir J. Lubbock and Mr. Bowles opposed the adjournment, which was supported by Mr. Mellor and Mr. J. Ellis.

Mr. Ritchie said he came down prepared to recommend the House, if the Bill remained in the shape in which it was introduced, to reject it, because it appeared to him that the principle of the Bill was a direct attack upon the rights, privileges, and duties of municipal corporations. It seemed to him, however, that his hon. friend, who had spoken in favour of the Bill, had practically removed all the difficulties they had in connection with the second reading. No doubt there were other matters to be dealt with, but the great question of principle having been removed from their consideration, it seemed to him that the House might very properly relegate this Bill in the ordinary course to a committee. They would have further opportunities of considering whatever amendments were made, and of seeing whether the undertaking which had been given was adequately carried out. If that were not done, they could reject the Bill, but to adjourn it *sine die* was a serious matter in the case of a Bill of these dimensions. He did not wish to express any strong view on the subject, but after the concession which had been made, he thought the Bill might be read a second time.

Mr. Whiteley inquired whether local as well as municipal authorities were to be included in the undertaking.

Mr. Bromley-Davenport said there could be no doubt whatever about his answer to that question; of course, it was in the negative.

Mr. Scott said the Bill was as objectionable to the larger local bodies as it was to the municipal authorities, and he, therefore, supported the adjournment, as he thought those bodies should have an opportunity of expressing their views.

Mr. Seely thought it would only be reasonable to adjourn the debate, the Bill having been seriously altered by leaving out the big towns.

Mr. Bryce thought that four-fifths of the objection to the Bill had been removed. He hoped the adjournment would be accepted without a division.

Sir J. Fergusson suggested that after the second reading an instruction should be passed to the Committee to insert clauses protecting municipalities.

Sir J. Woodhouse, as representing the Association of Municipal Corporations, agreed to the adjournment, but not to the suggestion of the right hon. gentleman the member for Sheffield.

Mr. Seton-Karr could not see what advantage would be gained by adjournment.

Colonel Pilkington thought the County Councils should be protected as well as the corporations.

The motion for the adjournment of the debate having been defeated by a majority of one, the debate was continued.

Mr. M'Kenna: May I ask the right hon. baronet (Sir J. Fergusson) whether he will move his instruction, and include urban districts as well as municipal corporations in the reservation clause?

Sir J. Fergusson: I shall place the notice on the paper, sir.

Mr. Burns, in continuing the debate on the second reading, said if the Bill were carried it would paralyse the future efforts of urban and district councils, which had as much right to be consulted as the large corporations which had protested against the measure.

Sir C. Dilke said the House would be laying down a most extraordinary principle if they exempted only municipal corporations from the operation of the Bill.

Mr. H. J. Wilson strongly protested against the passing of the Bill, and thought that the representatives of municipal corporations should not be allowed to secure their own ends at the expense of the smaller urban authorities.

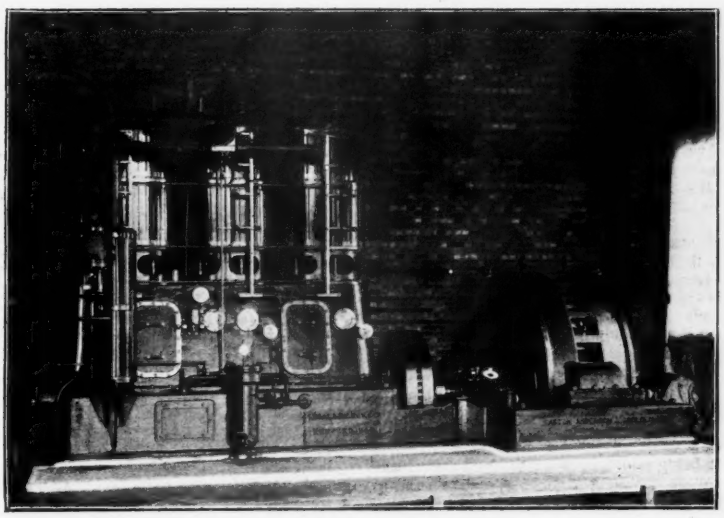
The House divided—

For the second reading	132
Against	164
Majority against	—32.

The Bill was accordingly rejected.

BEDFORD ELECTRIC LIGHTING PLANT.

We illustrate a standard set, designed and manufactured by Messrs. W. H. Allen, Son & Co., for electric lighting, electric transmission of power and tramway work. The plant actually shown is one of a set of four engines of the enclosed forced lubrication type, built by them for the Corporation of Bedford for town lighting, and is of the three-crank tandem compound enclosed type with forced lubrication. The three cranks are placed at equal angles of 120° to one another, and each crank is driven by a set of tandem compound cylinders arranged vertically above. It will be seen, therefore, that the engine consists of three sets of tandem compound engines working side by side. The reciprocating parts of the three tandem sets are exactly alike, so that the engine is well balanced, and can be worked at a high number of revolutions with the least amount of vibration. In addition to this, the turning moment is very uniform, a great advantage in central station work with different machines working in parallel. The cylinders are all cast separately of specially selected close grained iron. The high and low pressure cylinders of each tandem set are firmly bolted together, each tandem set being in turn bolted to an intermediate piece. The cylinders are fitted with piston valves, which are balanced; these valves work in cylindrical liners bored out truly in one setting after the cylinders are bolted together. The three intermediate pieces are supported by, and fixed to, a strong cast-iron framing called the trunk. This trunk is in turn supported by a massive bedplate, in which are fitted the main bearings for the crankshaft.



The trunk, as shown in our illustration, encloses the working parts. On the inside are cast the facings forming the guides of the crosshead feet. There are three hinged doors on the front of the trunk, and two doors at the back; these give easy access to all the working parts. The distance pieces already mentioned close in the upper part of the trunk, the piston and valve rods are made to pass through stuffing boxes in the base of the intermediate pieces. These stuffing boxes entirely separate the bottom part of the cylinder from the interior of the trunk, and answer the double purpose of preventing oil from the interior finding its way up the piston and valve rods into

the cylinders, and thence to the boilers and any water from the cylinders which may get through the cylinder glands from leaking into the crank chamber and displacing the oil. The bedplate, of very rigid design, has horns cast on, which carry the main bearings. The bottom part forms an oil reservoir, from which one or two force pumps draw the oil required for the lubrication of the working parts, and into which the oil again drains after having done its work. The horns for the main bearings are all truly bored out at one setting. The lubrication of the engine is carried out by means of two valveless force pumps, which force a continuous stream of oil under pressure, first through a filter, from which it is led by a system of pipes and channels to all the working surfaces. All the forged work in the engine is made of Siemens-Martin mild steel, with the exception of the crosshead, eccentric and smaller pins, which are made of special hard steel, and are ground up true. The steel is made to stand a breaking stress of from 28 to 32 tons per square inch, with an elongation in a 2-inch length of from 27 to 30 per cent.

A very powerful and sensitive centrifugal governor is fixed direct to the crankshaft and controls the throttle valve. With a fair amount of care in keeping governor and throttle valve clean and free, very close regulation can be obtained with this combination, the variation depending, to a great extent, upon the size of fly-wheel fitted to the engine.

OCEAN TELEGRAPHS.

Dr. A. E Kennelly, President of the American Institute of Electrical Engineers, delivered last month at the McGill University, Montreal, a course of four lectures on the subject of submarine cable telegraphy. These lectures, the New York *Electrical Engineer* says, were attended not only by the students, but by electrical people and others, and were very interesting. This we can readily appreciate, in view of the attention which submarine telegraphy is just now attracting in America in connection with the contemplated Pacific cable, and the special qualification of the lecturer to deal with the subject.

We glean the following brief abstracts from Dr. Kennelly's discourse, which, suitable to his audience, and owing to the extensive field traversed, was necessarily of a somewhat cursory and popular character.

Reference was made to the development of submarine telegraphy during its eventful though short history, practically comprised in the last half century, commencing with the first cable laid in 1850 across the Straits of Dover, consisting of but a single copper wire insulated with gutta-percha, and without any mechanical protection, and which, though it lasted but a few hours, demonstrated its electrical capabilities, and paved the way for greater successes in the years to come.* The practical success of the earlier experiments led to shallow water cables around the shores of the Mediterranean, and in 1859† the first cable bridged the depths of the Atlantic.

This triumph was short-lived, since the cable died a natural death in a few weeks' time. It was replaced, however, by a far better cable in 1866, the experience of the earlier trials having come to fruition, and since that time Europe and America have never been beyond speaking distance.

At the present time there are some 150,000‡ miles of cable laid throughout the world, and a fleet of more than 30‡ telegraph ships is employed to minister to their needs. Although this length of cable would be sufficient to girdle the world some six times, yet the actual girdle is incomplete at present at the Pacific Ocean, but it is now confidently expected that ere long this gap will be completed by a cable from the western coast of America to China or Japan.

The amount of the capital which has been expended in the enterprise of cable laying will be evident from the fact that cable costs, roughly, about £1,000 per mile.

There is no difficulty in laying a cable anywhere, but there is a considerable difficulty in laying a cable in such a manner as to minimise the risk of its fracture after being laid. It is a matter of experience that wherever a cable rests upon a rock it will break, and its rupture is only a question of attrition and time.

Those who build upon rock, so far as cables are concerned, build to their destruction, while those who build upon sand can expect dividends. The course on which a cable is to be laid should be thoroughly investigated beforehand by a ship, which makes a zigzag path over the course and sounds at frequent intervals, so as to insure the provision of a smooth and soft bed on which the cable shall be laid to rest, otherwise its slumbers will be interrupted by the rude shocks of rupture.

There is scarcely any series of engineering operations which has a greater fascination or possesses more romantic interest than submarine telegraphy in the picking up or repairing of cables. It is governed largely by time and tide and weather, and its fortunes are determined by a great variety of circumstances. Nevertheless, cables have been successfully repaired in the deepest water to which they have yet been committed.

The expense of repairs in deep water—say in two miles of water—is naturally much greater as a rule than the expense of repairs effected in shallow water; while in some cases very shallow water repairs may be effected in a small boat or sailing yacht at an expense which is relatively trivial.

The speed of signalling does not become any serious consideration until a cable is several hundreds of miles in length. In other words, rapid speed of hand signalling can be obtained over almost any kind of practical submarine cable up to a length of several hundred miles; but after a length of, say, 500 miles has been passed, it is necessary to employ delicate apparatus. With long cables it is necessary to employ a comparatively large size of copper wire or strand conductor and insulating gutta-percha envelope.

Enormous improvements have taken place in the speed of signalling or telegraphing through cables since the ocean was first spanned, a great deal in this direction being due to the inventive skill of Lord Kelvin. The *mirror galvanometer* instrument, which is so valuable an adjunct in the electrical laboratory, has been yet more valuable to the electrical fraternity in the operating room as a commercial signalling instrument, while the *siphon recorder* of later date has caught the fitful flickerings of the beams of light and has left their record traced upon a moving band of paper.*

* As this cable only lasted one day, it is rather the four-core cable, sheathed with 10 No. 1 galvanised iron wires, and weighing 7 tons per mile, which was laid in the following year (1851), and proved a brilliant success, which practically decided the practicability of submarine telegraphy.

† The date of this cable being completed we think should be August 5th, 1858.

‡ In Sir Henry Mance's inaugural address as President of the Institution of Electrical Engineers, March, 1897, the aggregate length of existing cables is given as not less than 162,000 nautical miles, and the number of telegraph ships as 41.—Eds. Elec. Rev.

CARBON-CONSUMING BATTERIES.

At a meeting of the Institution of Junior Engineers held at the Westminster Palace Hotel on March 3rd, the chairman, Mr. Basil Joy, presiding, a paper on "Carbon-Consuming Batteries, and their Possibilities," was read by Mr. W. R. Cooper, B.Sc., M.A., M.I.J.E. There was a large attendance.

The saving which might be effected in the cost of production of electrical energy by the use of a carbon-consuming battery was first discussed. The absolute mean efficiency of a steam plant, generating electrical energy for general supply purposes, might be taken as low as 6 per cent., as deduced from experiments by the late Mr. Willans, whereas the corresponding figure for a battery working under the same conditions was about 73 per cent. Assuming that a Board of Trade unit could be generated and distributed by the combustion of 10 lbs. of coal, and that the cost per unit was 3·31., with coal at 20s. per ton, then the efficiency of a battery rendered it possible to effect a saving of 30 per cent. of the cost per unit, provided that coke could be voltaically oxidised to CO_2, and that the electrolyte, and the plate opposed to the carbon, did not introduce additional expense. The cost of renewing the electrolyte and negative plates, however, might counteract the gain due to efficiency. It was also necessary to remember that the cost per unit depended upon maintenance, and that the price at which electrical energy could be supplied depended upon capital expenditure. For the consumer to derive much benefit from a carbon-consuming battery, a reduction in the capital expenditure, as well as in the coal bill, must be effected.

The author next considered the various difficulties in attempting to solve the problem of the direct production of electricity from carbon; they were due to (1) the insoluble nature of carbon, (2) the scarcity of electrolytes among carbon compounds, (3) the inability of carbon to act as an ion in such organic compounds as are electrolytes, (4) the electro-negative character of carbon. In the place of the oxidation of carbon, that of CO might be attempted; but the possible E.M.F. from such a reaction was lower than that theoretically obtainable from the oxidation of carbon. There was also a difficulty in finding electrolytes in which CO acted as an ion.

Suggestions for various forms of carbon-consuming cells were then reviewed. Grove's ordinary gas cell, in which the hydrogen may be replaced by CO, was of no commercial value, because the current obtainable appears to depend upon the rate of occlusion of the gases by the platinum. The cell brought out by Borchers with a view to the utilisation of CO had not proved successful; the E.M.F. was, in fact, not due to the oxidation of CO, but to the solution of the copper which is used as one of the plates. The problem had been attacked by Reed in a manner which was suggestive, but without much practical result; this investigator aimed at a cell having indestructible electrodes, and an electrolyte by means of which the carbon was oxidised, but which was regenerated by the action of the cell itself. The indirect production of electrical energy from carbon by the use of H_2S and SO_2 was ingenious, but no practical outcome could be obtained by the interaction of two liquids, because true voltaic action does not take place in that way. The utilisation of free carbon, combined with electrolytic solutions, had been attempted by Case and by Coehn. The Jacques cell was an example of one in which a fused electrolyte was employed. Owing to the many defects which are inherent in this form of cell, its efficiency was low; it also appeared extremely doubtful whether the electrical energy obtained was due to the voltaic consumption of carbon at all. Another cell of the same class was Blumenberg's, in which the same objectionable features were to be found as in the case of the Jacques cell.

Some interesting experiments were successfully shown, in illustration of the paper, and in the discussion which ensued Mr. H. B. Varley, Mr. W. B. Clarke, Mr. R. F. Krall, Mr. C. Lean, and Mr. A. W. Marshall took part. A vote of thanks having been accorded

* Under this heading Dr. Kennelly might have included in his survey the comparatively recent and more sensitive recording instrument invented by M. Ader, whereby signals received through a long cable are photographed on a band of sensitised paper.

the author, the proceedings concluded with the announcement of the ensuing visit on 25th inst. to the Testing Station of the British Fire Prevention Committee.

COOLING TOWER AND CONDENSER PLANT.

The non-use of condensing steam engines is sometimes explained to be due to the want of sufficient water to run the condenser. Such apologists, therefore, turn their exhaust steam into the air, and obtain feed water sufficient to feed their boilers. In doing this they overlook the fact that by means of cooling towers or atmospheric condensers, they could run their engines on the condensing system, and still use less water than when exhausting to the atmosphere. They would, in the first place, use less steam, and for each pound of steam they did use, they would require to purchase less than a pound of water. There are two systems in use for condensing exhaust steam, and doing so without using any extra water. One is to turn the steam through pipes, which are cooled externally by the atmosphere, aided by a constant stream of water which is made to flow in thin films over the pipes, and the pipes are preferably exposed to the open breeze. In another system the condensing water is pumped through a cooler, and exposed in finely divided streams to a blast of air. This latter process has been considerably worked in America, and a description of one such plant occurs in a recent paper to the American Society of Mechanical Engineers.

The plant is at an electric light station, containing 27 boilers, each 48 inches × 20 feet, set in pairs to a single furnace 8½ feet × 5 feet, the total fire grate surface being thus about 450 feet. The plant becoming too small, Mr. Vail suggested the water tower cooling system so as to eke out the engine power without calling for more steam. Before the alteration the combustion rate was 29·2 lbs., giving a from and at evaporation of 7·13 lbs. per pound of coal. Each 48-inch boiler with its 22 5-inch tubes was thus evaporating 4,281 lbs. per hour. After the test an 18½ × 30 Buckeye engine was converted into a compound condensing engine by fitting two new cylinders 14½ inches and 25 inches × 30 inches, and a new 750 H.P. compound condensing engine was put down with the necessary condenser equipment and a cooling tower of Barnard twin type. The tower is 12 feet 3 inches × 18 feet × 29 feet 6 inches high in two chambers. Water is delivered at the top by means of a 10-inch pipe feeding 96 distributing pipes laid across the tower top. These are perforated and provided with means for cleaning in cold weather when they clog with oil.

The water falls through or over 42 galvanised mats of No. 19 steel wire woven to No. 5 mesh. Each mat measures 12 feet by 15 feet 6 inches, and they afford a total of 8,064 square feet of surface. They are hung by galvanised hooks. Air is provided by two pairs of 8-feet diameter fans, the four being capable of delivering 360,000 cubic feet per minute at 150 revolutions. This air enters the lower chambers of the tower and flows uniformly between the mats.

The tower is expected to cool the circulating water to condense 12,500 lbs. of steam. The water is pumped in at 132° and leaves at 80° when the atmosphere does not exceed 75° nor its humidity 85 per cent. From lack of convenient room the total height from the condenser to the top of the tower is 58 feet, which calls for more power than ought normally to be required for such a plant. Each fan is driven by a vertical engine and can be varied in speed to suit requirements. Often in winter the fans do not need to be run. In the compounded Buckeye engine 332 I.H.P. is developed, and of this about 91 I.H.P. is below the atmospheric line, showing a saving of over this amount. From 20 to 26 inches of vacuum is obtained. In the new larger engine of 643 I.H.P., some 185 was found below the atmospheric line. The pump and fan engines showed 27½ H.P., showing a net gain of nearly 158 H.P.

Details are lacking as to the remaining engines, but it appears as though all the engines had been put on the condensing plant, as it is stated that an already overloaded station has been increased 1,000 H.P., and yet there are now boilers to spare as a result of the new system.

ELECTRICITY AS APPLIED TO METALLURGY.

In the *Australian Mining Standard* some time ago, Prof. Threlfall, of Sydney University, published an article under the above heading, which has not, we believe, hitherto received any notice from the technical journals of this country. As this article is not without interest, we give below a brief summary of its contents, referring readers to the paper named for further information upon the subjects and processes discussed.

The first portion of Prof. Threlfall's article is devoted to the theory of electrolysis; the second to its practical applications. The former presents in a clear manner some of the fundamental phenomena and laws of electrolytic action, and will be useful to those whose acquaintance with the modern theories of solution, and of the electrical conductivity of electrolytes is very limited.

Discussing the relationship between chemical activity and E.M.F. in primary and electrolytic cells, Prof. Threlfall points out that it is possible for a small current to be sent through most electrolytes with the aid of an E.M.F. much below that demanded by the given salt in solution. This fact is explained by certain investigations of von Helmholtz, which proved that dissolved gases play a great part in the compensating reactions going on within the cell. The work of Clausius, Hittorf, and Kohlrausch next receives notice, and the theories based upon this are discussed.

Prof. Threlfall does not consider that the "ionisation" of a dissolved salt carries with it the electrostatic charging of the ions; and he gives expression to the view that the ions only receive such charges when engaged in carrying an electric current through the electrolyte. This, of course, is not in accordance with the theory of electrolysis put forward in the latest German text-books on the subject.

After a consideration of the phenomena of polarisation and a discussion of the theory of secondary cells, Prof. Threlfall devotes some space to a consideration of the attempts that have been made to produce a satisfactory primary cell in which carbon shall be the positive electrode, and promises a fortune to the man who solves this problem.

The second part of the article is less useful than the first, since the data which Prof. Threlfall had at his command in preparing it were exceedingly scanty and incomplete. He draws attention to the difficulty of obtaining reliable information concerning what is going on inside electro-chemical or electro-metallurgical works—a difficulty of which we have full experience. Since Prof. Threlfall wrote his article, however, much has been published in the London and New York electrical papers upon this branch of the subject; and there is no doubt that in a few years the halo of mystery which has been permitted to surround industrial electro-chemistry and electro-metallurgy will be completely dispersed.

We give below a list of the various processes touched upon by Prof. Threlfall in this portion of his article, with a few details in those cases where new facts have been brought forward.

Electro-plating.—The author states that he has always obtained best results when using a current density of 10 amperes per square foot. Traces of colloids such as glue or tannin when present in the electrolyte generally improve the deposit, though no explanation has yet been given of the action of these substances.

Electro Metallurgy of Copper.—An account of the Siemens and Halske and the Hoepfner copper extraction processes. Nothing new.

Electrolytic Refining of Copper—Smith's, Hayden's, and Thofehrn's systems of vat and electrode arrangement are described. Prof. Threlfall states that in the latter the use of copper oxide for renewing the electrolyte plays an important part.

[Since the article was written the chief improvement in the process has been a great increase in the current density used in the depositing vats.]

The Moebuis Silver Refining Process.—The author states that this process is worked with copper slimes, fused and cast into anode plates. We doubt whether this is correct at the present date.

Electrolytic Soda and Bleach Processes.—The Castner-Kellner, Greenwood, and Hargreaves processes are described. The second has long since disappeared from the list of practicable processes; but Greenwood is reported to be working out a new one. (See Electrical Review, January 13th, 1899.)

Hypochlorites.—A description of the Hermite process for sewage treatment. Contains no new details.

Aluminium.—The author describes the Hall and Heroult processes. He states that the latter has been abandoned in favour of one in which aluminium sulphide is used in the electrolytic baths. This statement is incorrect.

Calcium Carbide.—The notes on this contain nothing new, except the suggestion that if sold at a reasonable price, calcium carbide may displace candles for mining purposes—in Australia we presume.

Zinc Ores.—The problem presented by the Zinc Lead Sulphide ores of the Broken Hill District is described, and the Schnabel report, the Marsh & Storer, and Siemens & Halske processes are dealt with. No new information is given concerning these, with the exception of the statement that Messrs. Siemens & Halske claimed to have overcome the difficulties arising from deposition of spongy zinc, by means of violent agitation of the electrolyte with air.

Prof. Threlfall's article, at the time of its publication, must have formed a valuable addition to the literature of the subject, especially in Australia where little was known concerning these new processes.

Owing to the attention that is now being given by leading London and New York electrical papers to the industrial developments which have occurred in recent years, and to the number of writers and investigators who have collected and published information bearing on this branch of the subject, the value of the practical portion of Prof. Threlfall's article is now somewhat discounted.

STEAM TURBINES.

By RANKIN KENNEDY.

(*Continued from page* 238.)

In a free deviation turbine the fluid should impinge only on the concave side of the blades of the wheel, as in fig. 7, without any pressure on the convex sides, hence the importance of expanding the steam before it enters the buckets or blades. If the steam enters at full pressure without being allowed to expand and acquire full velocity, it presses against

the convex sides to a large extent, and that pressure opposes the pressure on the concave side in its effort to drive the wheel. The wheel would, however, be driven in the direction

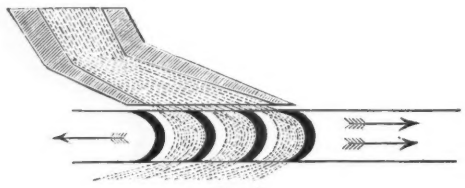


Fig. 7.

of the double arrow by the reaction of the steam against the concave sides.

In a purely free deviation turbine, the fluid does not come into contact with the convex sides at all. Its whole weight is thrown with the greatest velocity possible against the concave sides.

This is done in the De Laval turbine. The expanding nozzle, M, is seen in fig. 8 in section in plan, as shown in Patent 7,143, 1889.

A further improvement was, however, necessary to make an

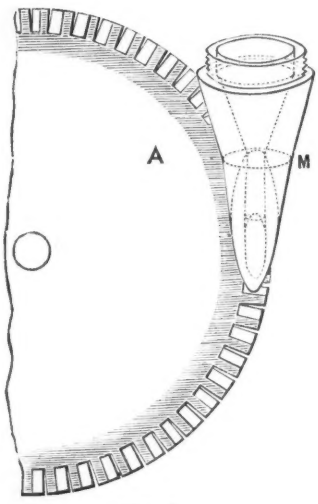


Fig. 8.

impulse steam turbine a success. A means of balancing the wheel at the extremely high velocities necessary for economy, was a necessity.

With ordinary shafts and bearings the slightest inequality of balance is fatal to the bearings, and it is almost an impossibility to construct wheels perfectly balanced.

De Laval reduces to a minimum these reactions on the bearings by making the shaft flexible or yielding, so that it is self-adjusting or self-balancing.

The shaft used is a long thin shaft almost a wire, as in fig. 9. Another plan is shown in fig. 10, here the shaft, F, passes from bearing to bearing rigidly, the wheel is mounted

Fig. 9.

on a thin tube, *a*, carried on the shaft by ferrules at each end. The tube is larger in bore than the diameter of the shaft, and is slotted for portions of its length on each side of the wheel, this makes it flexible or yielding enough to be self-balancing.

It may be pointed out here that there is one set of reactions on steam turbine bearings which seem to be entirely overlooked, namely, those which arise from gyroscopic actions on turbine wheels on board ship.

The motion of the ship throws great strains on bearings carrying wheels at enormous speeds.

The wheel persists in maintaining its plane of rotation as in a gyroscope, but the movement of the ship throws it forcibly out of its plane of rotation, and hence the strains. When used on board ship these gyroscopic strains could only

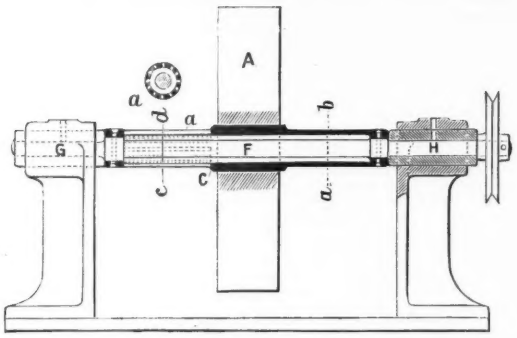


Fig. 10.

be met by hanging the turbine in gimbals, and there might be less of strain with the turbine axis fore-and-aft, instead of athwart the ship.

It is a point worth considering in turbine designs for marine purposes.

For electrical generators De Laval reduces the speed of turbine shaft to the dynamo shaft, by helical gearing, so that it may serve the double purpose of reducing speed and preventing end play on the turbine shaft, he makes the gearing double, one left-handed, and one right-hand spiral; two dynamos are geared to these, one to each side of the shaft.

This makes a very good mechanical arrangement, and is also handy electrically, as the two dynamos may be used in series, parallel, or separate, or in a three-wire system.

The helical gearing is shown in fig. 9 already referred to.

A further invention by De Laval essays to produce a vacuum in the turbine wheel case, without any special condenser requiring water.

He proposes for this purpose to use the principle of the ejector condenser, invented by Alexander Morton. The steam

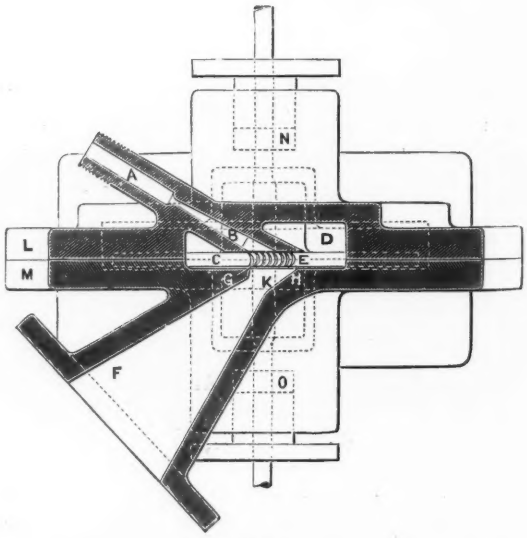


Fig. 11.

issuing from the wheel enters a throat, through which it rushes with a velocity due to any remaining pressure on it; in doing so it acts as an aspirator, or is supposed to do so, and produces a partial vacuum.

The fig. 11 shows the arrangement in section.

A is the steam entrance, B the expanding nozzle, C the wheel, the aspirator throat K, and expanding trumpet F.

It does not seem possible to get much benefit from this arrangement, except the small gain due to the wheel being slightly relieved from friction against the steam in the casing, it being reduced in pressure, but against this there is bound to be a back pressure at the exhaust throat.

We will next consider the pressure turbine, and turbines which act partially by pressure and partially by impulse.

The latter is the most numerous class, as it seems easier to make them than the purely pressure turbine.

The pressure turbine is the one theoretically best for series working, but the vast difficulty in the way of making the wheels steam tight between each wheel is almost insurmountable, especially when the wheels are numerous, as they must be get the full economy.

The purely pressure turbine acts exactly as Hero's engine, namely, by unbalanced pressures, sometimes called "reaction," but reaction is not a very expressive term for the actual cause of the wheels motion.

(*To be continued.*)

THE TELEPHONE QUESTION.

In the House of Commons on Monday night in Committee of Ways and Means, Mr. Hanbury moved a resolution on which to found a Bill for the improvement of telephonic communication. He explained in the first place that the measure would facilitate the extension of telephone exchanges by the Post Office. He claimed that the department had a perfect right to undertake the task of developing telephonic communication in rivalry with the National Telephone Company. It was the object of the Department to popularise this system of communication which was so vital to the trading and commercial interests of the country. At the same time the Department wish to deal as fairly as possible with the company. But the service supplied by the company was, he maintained, neither efficient nor sufficient, and it was limited practically to rich subscribers. It was not right that so important a medium of communication should be limited in that way. Under the Bill £2,000,000 would be placed at the disposal of the Post Office for the development of communication, and London would be the first place where action would be taken. The operations of the Department would be extended to smaller municipalities subsequently. London was dealt with first because the area of the London exchange was enormous, and because the number of its public wires was so large. With private wires the Post Office had no concern. Answering the question whether the Post Office was fitted to undertake work of this kind, he reminded the Committee that the Department had possession of the trunk wires, and that the Post Office exchanges had earned a considerable profit. It was not proposed to establish a mere subscription system, like that of the Telephone Company. The system in Switzerland would be copied and a small subscription of about £3 a year would be demanded, and then small fees or tolls would be paid as for telegrams. He believed that the Department would attract subscribers from classes which at present made no use of the telephone. Arrangements would be made to utilise the express messenger system in connection with telephone exchanges, and thus anybody, whether a subscriber or not, would be able to take advantage of the system. It was also intended to give certain large municipalities power to establish telephone systems, the necessary funds coming from the borough rates. A competing municipality would not have the right to refuse the National Telephone Company wayleaves which it took itself. As much as was useful of the plant laid down by municipalities would be purchased by the Post Office at the end of 1911, and corresponding treatment would be meted out to the telephone company.

Sir J. Fergusson (says the *Times*) defended the National Telephone Company against the charges which were brought against it and justified its policy, contending that it had done nothing to deserve punishment. He regretted, therefore, that it was proposed to treat the company with hostility.

Sir C. Cameron congratulated the Secretary to the Treasury upon his statesmanlike scheme, and Mr. Boscawen, Mr. Provand, and other members also expressed their approval.

Sir J. Lubbock doubted whether the telephone system would be more efficient under the Post Office, and regretted that the Government were ready to encourage municipalities to engage in business. He feared that the results of the scheme might be to check the development of the telephone and to increase local indebtness.

Mr. Begg thought the proposals of the Government were rash and likely to prove costly, and advocated a system of complete State control over the telephones.

Some other members having spoken, the resolution was agreed to.

Municipal Trading.—The Lancaster and District Chamber of Commerce, and other public bodies of a similar class, have this week been passing resolutions objecting to municipal trading, and asking the Government to relegate the matter to a committee.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1899.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, *to whom all inquiries should be addressed.*

3,704. "Improvements in and appertaining to electric street tramways." R. Riley, T. Winstanley and S. Riley. Dated February 20th.

3,734. "Improved process for electric smelting or reducing." W. Borchers. Dated February 20th. (*Complete.*)

3,735. "An improved method of, and apparatus for, utilising the waste gases and heat from electric furnaces." W. Borchers. Dated February 20th. (*Complete.*)

3,736. "Improvements in secondary batteries." J. Skwirsky. Dated February 20th. (*Complete.*)

3,742. "A combined thermo-electric or electro-thermal lamp." A. C. Brown. Dated February 20th.

3,746. "An improved electric switch." W. J. Murphy. Dated February 20th.

3,754. "An improvement in electric wall plugs." P. F. W. S. H. H. Berry and C. Rayner. Dated February 20th. (*Complete.*)

3,762. "Improvements in wireless telegraphy through water." R. J. Crowley and A. C. Oakes. Dated February 20th.

3,773. "An improved dynamometer for use in laying submarine cables." W. J. Murphy. Dated February 20th.

3,784. "Improvements in electric safety appliances." F. H. Badger and W. H. Plews. Dated February 20th.

3,836. "A new or improved process for roasting or calcining mineral substances by electrical currents especially adapted to the manufacture of Portland and like cements." R. J. Wallis-Jones and H. W. Couzens. Dated February 21st.

3,861. "Improvements in telegraph and telephone cables." T. Carles. Dated February 21st.

3,869. "Coin controlled and registering telephone apparatus." R. D. Cranston and S. M. Williams. Dated February 21st. (*Complete.*)

3,893. "Improvements in electrical signalling apparatus." The Anchor Electric Company and E. Freund. Dated February 22nd.

3,899. "'The Oxford watch lamp,' an improvement in electric cycle lamps." J. F. Pierce. Dated February 22nd.

3,904. "Improvements in telephone exchange switches for use in public central stations, large institutions, police service, and the like." A. E. Slater. Dated February 22nd.

3,910. "Improvements in starting alternating single-phase electro-motors and in apparatus therefor." R. Kennedy. Dated February 22nd.

3,936. "Electric bell for velocipedes." A. Bodenheimer. Dated February 22nd.

3,943. "Improved means for establishing connection between underground electric circuits and electro-motors of vehicles." J. H. Betteley. Dated February 22nd.

3,947. "Improvements in apparatus for applying electric currents of high frequency to telegraphy." T. Carles. Dated February 22nd.

3,999. "Improvements in electric traction for tramcars and the like." J. Milnes. Dated February 23rd.

4,001. "Improvements in and relating to starting switches and resistances for electric motors."

4,007. "Improvements in electrically controlled switches." R. E. B. Crompton and E. A. N. Pochin. Dated February 23rd.

4,027. "Improvements in automatic electric warning signals for railways and the like." J. H. Hollyer. Dated February 23rd.

4,046. "Improvements in or connected with electric motors and generators and other electric apparatus and instruments." V. A. Fynn. Dated February 23rd.

4,059. "Improvements in incandescent electric lamps." T. D. Farrall. Dated February 23rd.

4,065. "Improvements in electrical switches." Veritys, Limited, and L. J. Steele. Dated February 23rd.

4,068. "A new and useful method of manufacturing electric resistances." S. S. Bromhead. (W. C. Heraeus, Germany.) Dated February 23rd. (*Complete.*)

4,078. "A new or improved machine tool particularly applicable for refacing or turning commutators of electric generators and the like." D. Honeywood. Dated February 24th.

4,082. "Improvements in accumulators and storage cells, portable and stationary." F. H. Stone. Dated February 24th.

4,088. "An improved lampholder for incandescent electric lamps." W. Lynes. Dated February 24th.

4,111. "Magnetic needle indicator puzzle." W. Rayward, G. W. Dancy, and F. Westwood. Dated February 24th.

4,119. "Improvements in the mode and means for operating the poles or masts of electrical cars or vehicles for tramways." W. Rutherford. Dated February 24th. (*Complete.*)

4,121. "Improvements in miners' safety lamps and in means for electr.cally igniting the same." W. Best. Dated February 24th.

4,122. "Improvements in or connected with induction coils, especially applicable for use in mines." W. Best. Dated February 24th.

4,123. "Improvements in electric glow and arc lamps." S. G. Brown. Dated February 24th.

4,124. "An improvement in electric stoves." H. J. Dowsing. Dated February 24th.

4,137. "A new or improved galvanic bandage." P. L. Schmidt. Dated February 24th. (*Complete.*)

4,143. "Improvements in letter cards and telegraph cards." E. Tissot. Dated February 24th.

4,158. "Improvements in transformers for continuous electric currents." A. Wydts and G. Weissmann. Dated February 24th. (Date applied for under Patents, &c., Act, 1883, Section 103, August 4th, 1898, being date of application in France.)

4,190. "Improvements in electrically propelled vehicles." R. F. Hall. Dated February 25th.

4,210. "Improvements in and connected with electrical traction." W. Kingsland. Dated February 25th.

4,224. "An electrical recording instrument." W. H. Wheatley. (H. R. Lockhart and R. O. King.) Dated February 25th.

4,231. "Improvements in arc lamps." W. C. Johnson and A. Wunderlich. Dated February 25th. (*Complete.*)

4,232. "Improvements in electro-motor road vehicles." La Societe Geoffroy et Delore. Dated February 25th. (Date applied for under Patents, &c., Act, 1883, Section 103, August 29th, 1898, being date of application in France.)

4,244. "Improvements in or in connection with primary electric batteries." H. T. Harrison. Dated February 25th.

ELECTRICAL PATENTS OF 1885 EXPIRING IN MARCH, 1899.

We are informed by W. P. Thompson & Co., that about 90 applications for electrical patents were filed in the month of March, 1885. Of these some were never completed, and of those that were only four have been maintained to run their full length of term, viz., 14 years, and being of considerable interest we give short abstracts of them below:—

2,765. "Improvements in and relating to electrical accumulators or secondary batteries." W. R. Lake (Marchenay, A.) Dated March 2nd, 1885. Relates to secondary batteries. Chloride of lead is cast into a plate with about 3 to 6 per cent. of chloride of zinc, a rod of lead or platinum being inserted to form the connection. The plate so formed is placed in a saturated solution of chloride of zinc in contact with zinc; chloride of lead then crystallises in long needles. After washing in water and dilute acid to remove the chloride of zinc and zinc, the plate is ready for use, but may be first peroxidised in any suitable manner. Other fusible chlorides may replace the chloride of zinc, especially sal-ammoniac; or oxy-chlorides of lead may be used; or lead chloride may be mixed with asbestos. 11 claims.

3,379. "Improvements in distributing electricity and apparatus therefor." W. P. Thompson (C. Zipernowsky and M. Deri.) Dated March 16th, 1885. Relates to distributing by means of induction coils, the leading object being the regulation of the electromotive force at the various distributing centres. These centres are supplied from a central dynamo, and may each have several induction coils with their primaries in series or in parallel, but the various centres themselves are in parallel with respect to the main leads. The electromotive force between these leads is maintained constant automatically by regulating the field current of the dynamo. In an alternating dynamo the field magnets revolve while the armature coils are stationary. The coils are employed to excite the magnets, the currents being reversed by the commutator. This circuit contains one coil of the regulating induction coil; the other coil is in the main circuit supplied by the armature coils. The electromotive force on the distributing centres in multiple arc is kept constant. The coils tend to send a constant current through the field magnets, while the induction in the induction coil superposes a variable current according to the requirements of the centres. In another arrangement the constant part of the exciting current is supplied by a separate machine. 1 claim.

3,813. "Improvements in electric signalling apparatus." F. B. Herzog. Dated March 24th, 1885. The apparatus, which is adapted for use in telephone exchanges, district and hotel telegraph circuits, &c., is so arranged that when set for a given signal it does not at once transmit such signal, but remains set until released by the attendant at the receiving station. A shaft carries a contact arm as well as a handle by which a driving spring can be wound up. Loose on the shaft are three pointers with three knobs and circular arcs. These pointers also carry pieces, two of which serve to interrupt the contacts, and the third to stop the contact arm altogether. The pointers are set by hand so that their arcs overlap each other to the required extent, the first being set in position relative to a fixed stud. When the contact arm is released from the receiving station it is moved by the spring and transmits a series of currents, interruptions being made at intervals of 2 and 7 breaks successively, and the arm finally stopped after 10 more breaks. When it is desired to extend the capacity of the instrument, more than three pointers may be used. A flap serves to cover the face of the instrument when set. The apparatus may be used as a telegraph or telephone call. 15 claims.

3,857. "Improvements in electrical switches." S. Z. de Ferranti. Dated March 25th, 1885. Switches constructed to reduce the sparking on making and breaking circuits. For small currents the contact is made or broken very suddenly by the action of two spiral springs, projecting on opposite sides of an insulating axis. The upper extremity of the axis carries a handle and a disc having at two diametrical points of its circumference two or three teeth with which a ratchet engages. On rotating the axis the springs are compressed until they suddenly leave the contacts and fly against stops. For large currents a shunt is combined with the above method, or with simple bridging contacts. Consists of the case containing the apparatus and the terminals to which the contact springs are attached. A pivoted drum contains a liquid which completes the circuit in certain positions between the two sets of plates. The plates are in electric connection with the drum, and the other set of plates are connected through posts with an insulating metal strip on the end of the drum. The contacts are so arranged that the main circuit is first broken and then the shunt circuit is broken by the withdrawal of the plates from the liquid on further rotation. A valve is provided to allow any liberated gases to escape. The disc is connected by a coiled spring to the disc on the axis, and is provided with one tooth which engages with either of two teeth on a rocking frame; it is released from the frame by a projection on the disc when the spring is compressed and ready to move the drum. 4 claims.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, *price, post free,* 9*d.* (*in stamps*).

1897.

5,948. "Improvements in means and apparatus for discharging, neutralising, or removing electrical charges from paper and other fabrics during and after the process of manufacture." H. J. Rogers and W. M. Mordey. Dated March 6th, 1897. Near one or both surfaces of the paper or other material are arranged large areas of points electrically connected with the earth or with a generator for producing electricity of opposite sign to that in the paper. In addition to the systems of points, wire brushes may be arranged to press lightly on the surface of the paper. The upper set of points may be carried by a balanced frame or connected with the lower one by right and left handed screws. 5 claims.

6,081. "Improvements in apparatus for electric lighting." J. H. McLean. Dated March 8th, 1897. In street lighting systems with arc and incandescent lamps, the latter are automatically switched into the circuit when the former are extinguished. A solenoid is in shunt with the lamp, and its core carries a contact adapted to complete the circuit of the incandescent lamps, when it drops, owing to failure of current through the solenoid. A time switch may be employed to open the incandescent light circuit at daybreak. 2 claims.

6,276. "Improvements in electric arc lamps." R. E. B. Crompton and E. A. N. Pochin. Dated March 10th, 1897. Relates to arc lamps. Clutch lamps with enclosed arcs are constructed in section. The lamp frame has an iron base-plate shielded by asbestos and carrying rods provided with spring catches to support a sliding frame in the position illustrated, or in a lower position. The base of the frame supports an outer globe and a socket and spring carrying a holder for an inner globe and the lower carbon. Similar supports are described for another purpose in specification No. 15,840, A.D. 1892. The inner globe is clamped by asbestos washers. It is held up against a cover below the rounded end of a gas-check in the base-plates. The gas-check has a circularly-grooved hole to pass the upper carbon. This is carried by a clutch of any ordinary form at the lower end of a brass tube carried by a yoke with two cores within series solenoids. The upper carbon is guided by a cap in which it is held by a bent blade spring; the cap has projecting wire brushes, and slides in the brass tube. The movements of the cores are checked by a dash-pot. The solenoids may otherwise be differentially wound, or a shunt solenoid may be arranged to act on a core and switch to short circuit a part of the series solenoids if the arc becomes too long. A shunt-wound cut-out for the lamp may be provided, and may replace a resistance provided in the lamp. 5 claims.

6,307. "Improvements in pegs and their cords for telephone exchanges." Siemens Bros & Co., Limited. (Siemens & Halske, Germany.) Dated March 10th, 1897. Cords are attached to plugs by passing the cord first through the sleeve, the bore of which is enlarged at each end, and then making the contacts. A binding is then put round the cord, and it is so drawn back that the plug rests in the sleeve and the binding is firm against the internal shoulder. An envelope of cloth or other material is then forced into the sleeve around the cord and a binding placed on the outside. 2 claims.

6,720. "A new or improved electrical apparatus for perforating designs." P. E. Glorget. Dated March 15th, 1897. Relates to a pen for perforating designs in sheets of cardboard and the like for use as stencil plates. The needle is held by the ring in the bore of which is enlarged at each end, and then making the contacts. A binding is then put round the cord, and it is so drawn back that the plug rests in the sleeve and the binding is firm against the internal shoulder. An envelope of cloth or other material is then forced into the sleeve around the cord and a binding placed on the outside. 2 claims.